MODEL

AJ-15 FM-FM Stereo Solid-State Tuner

HEATHKIT®

ASSEMBLY MANUAL



HEATH COMPANY • BENTON HARBOR, MICHIGAN

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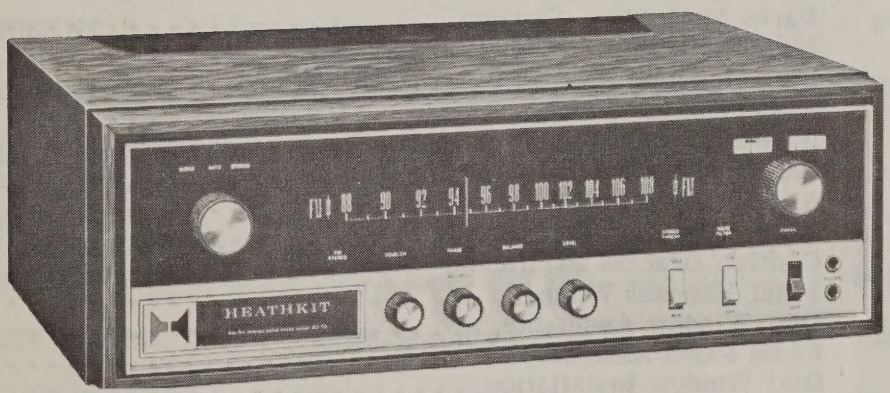
Assembly and Operation

of the

HEATHKIT

FM-FM STEREO SOLID-STATE TUNER

MODEL AJ-15



NOTE: THE AJ-15 TUNER IS SHOWN IN THE AE-18 ACCESSORY CABINET.

HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

TABLE OF CONTENTS

INTRODUCTION. 4

UNPACKING. 5

MULTIPLEX CIRCUIT BOARD
Parts List. 6
Step-By-Step Assembly. 8

FM CIRCUIT BOARD
Parts List. 17
Step-By-Step Assembly. 19

CHASSIS
Parts List. 32
Step-By-Step Assembly. 34
- Parts Mounting - Chassis. 34
- Light Reflector Assembly. 36
- Dial Stringing. 38
- Transformer Wiring. 40
- Harness Wiring. 42
- Rear Apron Assembly And Wiring. 44
- Alternate Line Voltage Wiring. 47
- Control Bracket Assembly. 48
- Control Bracket Preliminary Wiring. 50
- Final Harness Wiring. 52
- Dial Window Assembly. 54
- Front Panel Assembly. 55
- Dial Window Installation. 55
- Meter Wiring. 56
- Front Panel Mounting. 56
- Knob Installation. 58

ADJUSTMENTS
FM Adjustments. 61
Multiplex Adjustments. 62

FINAL ASSEMBLY. 65

INSTALLATION
System Connections. 67
Mounting The Tuner. 69

OPERATION. 73
Normal Operation Reproduction Chart. 74

IN CASE OF DIFFICULTY
Introduction. 75
General Section. 76
Troubleshooting Charts. 77
Stage-By-Stage Signal Injection. 82

ALIGNMENT. 84

SPECIFICATIONS. 91

CIRCUIT DESCRIPTION
FM Tuner Circuits. 93
Multiplex Circuits. 97
Audio Output Circuits. 103
Power Supply Circuits. 104

CIRCUIT BOARD X-RAY VIEWS. 105

VOLTAGE CHARTS. 107

CHASSIS PHOTOGRAPH. 109

REPLACEMENT PARTS PRICE LIST. 110

SCHEMATIC . . . . .(fold-out from page). 115

Warranty . . . . . Inside Front Cover

Customer Service . . . . . Inside Rear Cover

INTRODUCTION

The Heathkit Model AJ-15 FM-FM Stereo Tuner includes the most up-to-date solid-state circuitry to provide the ultimate in FM reception. To insure maximum listening pleasure, the Tuner includes such circuit features as a pre-assembled tuning unit that uses field-effect transistors to provide high sensitivity and low cross-modulation, with no overload on strong local stations. Two integrated circuits, each containing ten transistors and seven diodes in a space normally taken by one ordinary transistor, are used to both amplify and limit the IF signal. Two IF crystal filters provide excellent bandpass characteristics with minimum phase shift and sharp selectivity.

Tuner operation is simplified by having all primary controls and switches on the front panel. Secondary controls, which only need adjusting when the Tuner is first completed, are located on the chassis and circuit boards.

The Selector switch has three positions: Mono, Auto, and Stereo. In the Mono position, the multiplex circuits are turned off and all stations (monophonic and stereophonic) are reproduced monophonically. In the Auto position, monophonic stations are reproduced monophonically, and stereophonic stations are reproduced stereophonically. In the Stereo position of the Selector switch, only stereophonic stations are reproduced; all monophonic stations are rejected and there is no output from the Tuner.

The Squelch control and Threshold switch can be set so the listener will only hear those stations that are above an acceptable noise level.

Balance of the left and right channel outputs for variable and headphone output connections can be adjusted with the Balance control. The dual Level control affects the output level of the three sets of variable output circuits (two Phone jacks on the front panel and one set of variable output connectors on the rear of the chassis). The two sets of fixed output connectors (on the rear of the chassis) can be used for driving an amplifier or the input of a tape recorder.

Two front panel meters help you tune in stations accurately. The Tune meter indicates zero at the exact center frequency of an FM station. The Signal meter normally indicates the relative strength of the signal being received. This meter can also be switched into the multiplex circuit to aid in the adjustment of the 19 kHz pilot signal for maximum output.

The conservatively rated power supply circuit provides regulated, low-ripple DC voltages for the various tuner circuits. The power transformer, with its dual primary winding, can be wired for either 120 VAC or 240 VAC line voltage.

Most of the components in the Tuner are mounted on two circuit boards; there are only a very few chassis-mounted parts. A cable assembly with color coded wires connects to numbered holes in the circuit boards to minimize assembly time and reduce the possibility of wiring error.

A back-lighted slide-rule type dial, a die-cast front panel, and a walnut cabinet (optional) give the Tuner an impressive appearance that matches its high performance. This Tuner is certain to give you many pleasant hours of excellent listening pleasure.

UNPACKING

The complete kit is packaged in a large shipping carton, which contains smaller packages and a number of loose parts. Some of the smaller packages have the number 1 or 2 stamped on them. After the packages numbered 1 and 2 have been removed from the large carton, the remaining parts in the carton will be considered to be package 3.

Each of the assembly sections of the Manual contains its own Parts List and Step-By-Step instructions. At the beginning of each Parts List you will be told which numbered package to open. You will also be directed to remove some of the parts from package 3 to complete each assembly section.

To avoid intermixing parts, do not open any of the parts packages until directed to do so at the beginning of a Parts List. Any part that is packaged in an individual envelope with a part number on it should be placed back in its envelope after it is identified. It should not be removed from the envelope until it is called for in a step. This will aid in parts identification as you assemble the kit.

Refer to the "Kit Builders Guide" for additional information on unpacking, parts identification, tools, wiring, soldering and step-by-step assembly procedures.

Federal Communications Commission requirements prescribe maximum RF radiation from receivers operating above 30 MHz. This Tuner will meet these requirements when constructed in strict accordance with the instructions in this Manual, using only components and materials supplied with the kit or the exact equivalent thereof. You will be instructed to sign and affix a label to the Tuner certifying that you have constructed this Tuner in accordance with the above mentioned instructions. In order to meet legal requirements, be certain to follow the instructions as they are stated in this Manual.

MULTIPLEX CIRCUIT BOARD

PARTS LIST

Unpack the package marked 1 and check each part against the following Parts List. The numbers in parentheses are keyed to the numbers on the Multiplex Circuit Board Parts Pictorial (fold-out from Page 7).

To order replacement parts, refer to the Replacement Parts Price List and use the Parts Order Form furnished with this kit. If a Parts Order Form is not available, refer to "Replacement Parts" inside the rear cover of the Manual.

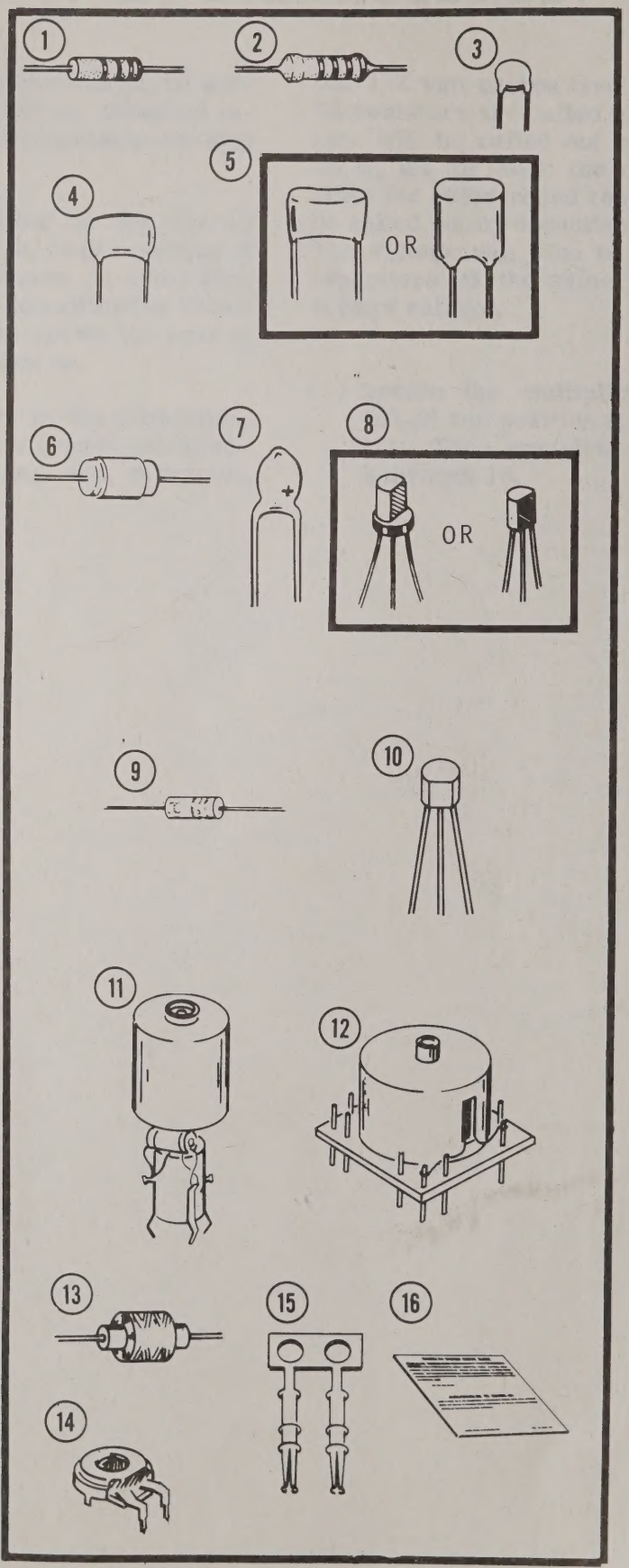
PART No.	PARTS Per Kit	DESCRIPTION
RESISTORS		
1/2 Watt (carbon)		
(1)1-1	1	47 Ω (yellow-violet-black)
1-42	1	270 Ω (red-violet-brown)
1-4	1	330 Ω (orange-orange-brown)
1-48	1	390 Ω (orange-white-brown)
1-6	1	470 Ω (yellow-violet-brown)
1-9	3	1000 Ω (brown-black-red)
1-10	1	1200 Ω (brown-red-red)
1-11	2	1500 Ω (brown-green-red)
1-44	6	2200 Ω (red-red-red)
1-19	1	6800 Ω (blue-gray-red)
1-73	2	8200 Ω (gray-red-red)
1-20	4	10 kΩ (brown-black-orange)
1-21	4	15 kΩ (brown-green-orange)
1-22	1	22 kΩ (red-red-orange)
1-23	4	27 kΩ (red-violet-orange)
1-25	5	47 kΩ (yellow-violet-orange)
1-60	1	68 kΩ (blue-gray-orange)
1-26	3	100 kΩ (brown-black-yellow)
1-27	2	150 kΩ (brown-green-yellow)
1-29	3	220 kΩ (red-red-yellow)
1-35	3	1 MΩ (brown-black-green)
1-38	1	3.3 MΩ (orange-orange-green)
1/2 Watt 5% (low-noise)		
(2) 4-15	2	1000 Ω (brown-black-red)
4-18	2	3300 Ω (orange-orange-red)
4-19	1	3900 Ω (orange-white-red)
4-20	3	4700 Ω (yellow-violet-red)
4-37	1	6800 Ω (blue-gray-red)
4-38	1	9100 Ω (white-brown-red)
4-22	5	10 kΩ (brown-black-orange)
4-39	3	12 kΩ (brown-red-orange)
4-23	1	22 kΩ (red-red-orange)
4-25	2	27 kΩ (red-violet-orange)
4-26	4	33 kΩ (orange-orange-orange)
4-27	2	47 kΩ (yellow-violet-orange)
4-29	3	220 kΩ (red-red-yellow)
4-32	1	390 kΩ (orange-white-yellow)
4-46	2	1.5 MΩ (brown-green-green)

PART No.	PARTS Per Kit	DESCRIPTION
CAPACITORS		
Disc		
(3)21-7	1	33 pF
21-75	3	100 pF
21-56	5	470 pF
21-140	1	.001 μF
21-27	2	.005 μF
21-82	1	.02 μF
21-100	1	.47 μF
Mica		
(4)20-108	1	200 pF
20-115	2	300 pF
20-107	2	680 pF
Mylar*		
(5)27-74	6	.01 μF
27-73	4	.047 μF
27-47	5	.1 μF
27-85	2	.22 μF
Polystyrene		
(6)29-5	1	1000 pF
29-6	1	1200 pF
29-4	4	1800 pF
29-3	1	2700 pF
29-8	2	3300 pF
29-9	1	8200 pF
29-2	1	10,000 pF (.01 μF)
Electrolytic		
(7) 25-220	4	10 μF tantalum
25-223	1	47 μF tantalum

*DuPont Registered Trademark

PART No.	PARTS Per Kit	DESCRIPTION
TRANSISTORS - DIODES		
NOTE: Transistors will be marked with either the part number or transistor type number.		
(8)417-94	1	2N3416 transistor
417-118	11	2N3393 transistor
417-201	8	X29A829 transistor
(9)56-26	8	1N191 diode (brown-white-brown)
(10)56-614	4	Dual diode (MSD6101)
COILS - CHOKE - CONTROL - CONNECTOR - SOLDER		
(11)40-787	2	7 mH coil (67 kHz trap)
40-788	2	20 mH coil (19 kHz trap)
40-789	1	23 mH coil (53 kHz lowpass)
40-790	3	70 mH coil
(12)40-786	1	7 mH coil (19 kHz amplifier)
40-791	1	7 mH coil (19 kHz doubler)
40-792	1	7 mH coil (38 kHz oscillator)
(13)45-47	1	2 mH RF choke
(14)10-155	1	750 Ω control
(15)259-20	2	Connector pin
		Solder
ITEMS FROM PACKAGE 3		
85-167-5	1	Multiplex circuit board
597-308	1	Kit Builders Guide
597-260	1	Parts Order Form
(16)390-1163	1	Certification label
391-34	1	Blue and white label
	1	Manual (See front cover for part number.)

MULTIPLEX CIRCUIT BOARD PARTS PICTORIAL



STEP-BY-STEP ASSEMBLY

Before you start the assembly of this kit, be sure to read the Kit Builders Guide for complete information on wiring, soldering, and step-by-step assembly procedures.

Components will be installed on the circuit boards in the following steps. Only a portion of the circuit board will be shown on some Pictorials. In these cases, an identification drawing at the top of the Page shows the area of the circuit board being worked on.

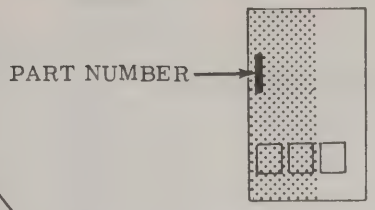
Position all parts as shown in the Pictorials. Follow the instructions carefully and read the entire step before performing the operation.

Use 1/2 watt carbon type resistors unless 1% or 5% resistors are called for in a step. All resistors will be called out by the resistance value (in Ω, kΩ, or MΩ); the color code will also be given for color-coded resistors. Capacitors will be called out by capacitance value (in pF or μF). The voltage will also be listed when there are capacitors of the same value but at different voltage ratings.

( ) Locate the multiplex circuit board (#85-167-3) and position it as shown in Pictorial 1-1. Then complete the steps on Pages 9 through 16.

IDENTIFICATION DRAWING

PART NUMBER



START

( ) 1000 Ω (brown-black-red).

( ) 12 kΩ 5% (brown-red-orange).

( ) 2200 Ω (red-red-red).

( ) 47 kΩ 5% (yellow-violet-orange).

( ) 33 kΩ 5% (orange-orange-orange).

( ) 4700 Ω 5% (yellow-violet-red).

( ) 15 kΩ (brown-green-orange).

( ) 1 MΩ (brown-black-green).

( ) 47 kΩ (yellow-violet-orange).

( ) 47 kΩ (yellow-violet-orange).

( ) Solder all connections and cut off the excess lead lengths.

( ) 68 kΩ (blue-gray-orange).

( ) 1000 Ω (brown-black-red).

( ) 10 kΩ (brown-black-orange).

( ) 10 kΩ (brown-black-orange).

( ) 3.3 MΩ (orange-orange-green).

( ) 1 MΩ (brown-black-green).

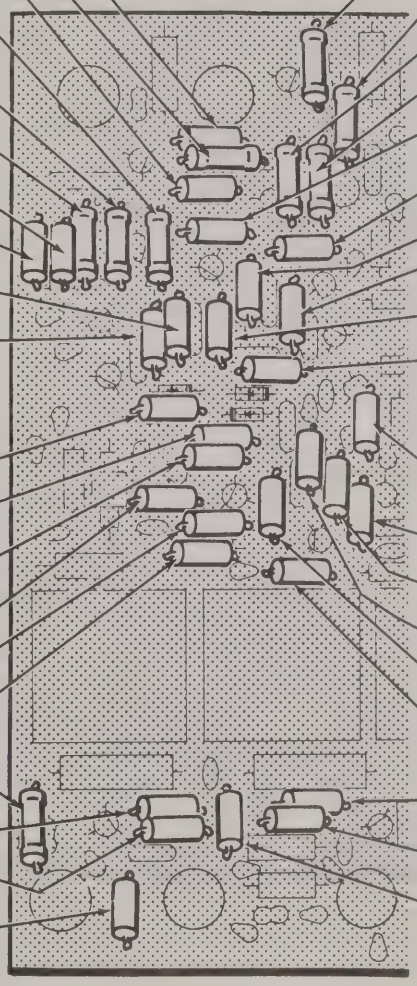
( ) 3900 Ω 5% (orange-white-red).

( ) 2200 Ω (red-red-red).

( ) 150 kΩ (brown-green-yellow).

( ) 2200 Ω (red-red-red).

( ) Solder all connections and cut off the excess lead lengths.



CONTINUE

( ) 1.5 MΩ 5% (brown-green-green).

( ) 220 kΩ 5% (red-red-yellow).

( ) 3300 Ω 5% (orange-orange-red).

( ) 1000 Ω 5% (brown-black-red).

( ) 22 kΩ (red-red-orange).

( ) 2200 Ω (red-red-red).

( ) 47 kΩ (yellow-violet-orange).

( ) 27 kΩ (red-violet-orange).

( ) 220 kΩ (red-red-yellow).

( ) 47 kΩ (yellow-violet-orange).

( ) Solder all connections and cut off the excess lead lengths.

( ) 10 kΩ (brown-black-orange).

( ) 27 kΩ (red-violet-orange).

( ) 15 kΩ (brown-green-orange).

( ) 270 Ω (red-violet-brown).

( ) 47 Ω (yellow-violet-black).

( ) 8200 Ω (gray-red-red).

( ) 330 Ω (orange-orange-brown).

( ) 220 kΩ (red-red-yellow).

( ) 150 kΩ (brown-green-yellow).

( ) Solder all connections and cut off the excess lead lengths.

PROCEED TO PICTORIAL 1-2.

PICTORIAL 1-1

START

( ) 1 MΩ (brown-black-green).

( ) 15 kΩ (brown-green-orange).

( ) 6800 Ω 5% (blue-gray-red).

( ) 47 kΩ 5% (yellow-violet-orange).

( ) 1500 Ω (brown-green-red).

( ) 22 kΩ 5% (red-red-orange).

( ) 1200 Ω (brown-red-red).

( ) 47 kΩ (yellow-violet-orange).

( ) 27 kΩ (red-violet-orange).

( ) 27 kΩ (red-violet-orange).

( ) 220 kΩ (red-red-yellow).

( ) 15 kΩ (brown-green-orange).

( ) 8200 Ω (gray-red-red).

( ) Solder all connections and cut off the excess lead lengths.

( ) 100 kΩ (brown-black-yellow).

( ) 2200 Ω (red-red-red).

( ) 100 kΩ (brown-black-yellow).

( ) 6800 Ω (blue-gray-red).

( ) 10 kΩ (brown-black-orange).

( ) 1500 Ω (brown-green-red).

( ) 9100 Ω 5% (white-brown-red).

( ) 12 kΩ 5% (brown-red-orange).

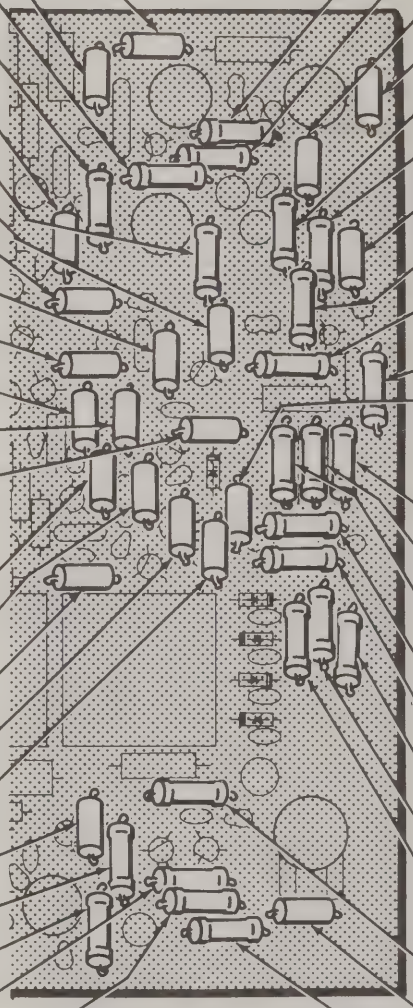
( ) 220 kΩ 5% (red-red-yellow).

( ) 390 kΩ 5% (orange-white-yellow).

( ) Solder all connections and cut off the excess lead lengths.

IDENTIFICATION DRAWING

PART NUMBER



CONTINUE

( ) 4700 Ω 5% (yellow-violet-red).

( ) 33 kΩ 5% (orange-orange-orange).

( ) 1000 Ω (brown-black-red).

( ) 2200 Ω (red-red-red).

( ) 1000 Ω 5% (brown-black-red).

( ) 12 kΩ 5% (brown-red-orange).

( ) 100 kΩ (brown-black-yellow).

( ) 220 kΩ 5% (red-red-yellow).

( ) 1.5 MΩ 5% (brown-green-green).

( ) 3300 Ω 5% (orange-orange-red).

( ) 390 Ω (orange-white-brown).

( ) Solder all connections and cut off the excess lead lengths.

( ) 33 kΩ 5% (orange-orange-orange).

( ) 27 kΩ 5% (red-violet-orange).

( ) 33 kΩ 5% (orange-orange-orange).

( ) 27 kΩ 5% (red-violet-orange).

( ) 10 kΩ 5% (brown-black-orange).

( ) 10 kΩ 5% (brown-black-orange).

( ) 10 kΩ 5% (brown-black-orange).

( ) 10 kΩ 5% (brown-black-orange).

( ) 4700 Ω 5% (yellow-violet-red).

( ) 470 Ω (yellow-violet-brown).

( ) 10 kΩ 5% (brown-black-orange).

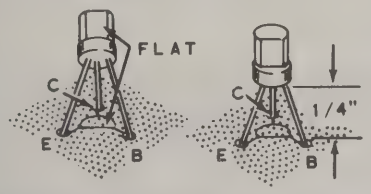
( ) Solder all connections and cut off the excess lead lengths.

PICTORIAL 1-2

PROCEED TO PICTORIAL 1-3.

START

NOTE: When installing transistors in the following steps, be sure to position the E, B, and C leads of each transistor into the corresponding E, B, and C holes of the circuit board. Position the transistor over its outline and 1/4" above the circuit board. Solder all three connections and cut off the excess lead lengths as each transistor is installed.



Install 2N3393 transistors (#417-118) at the following locations.

( ) 2N3393 transistor at Q406.

( ) 2N3393 transistor at Q402.

( ) 2N3393 transistor at Q401.

( ) 2N3393 transistor at Q416.

( ) 2N3393 transistor at Q419.

( ) 2N3393 transistor at Q407.

( ) 2N3393 transistor at Q414.

NOTE: The next transistor only is a 2N3416 (#417-94). It is installed the same as the other transistors on this Pictorial.

( ) 2N3416 transistor at Q420.

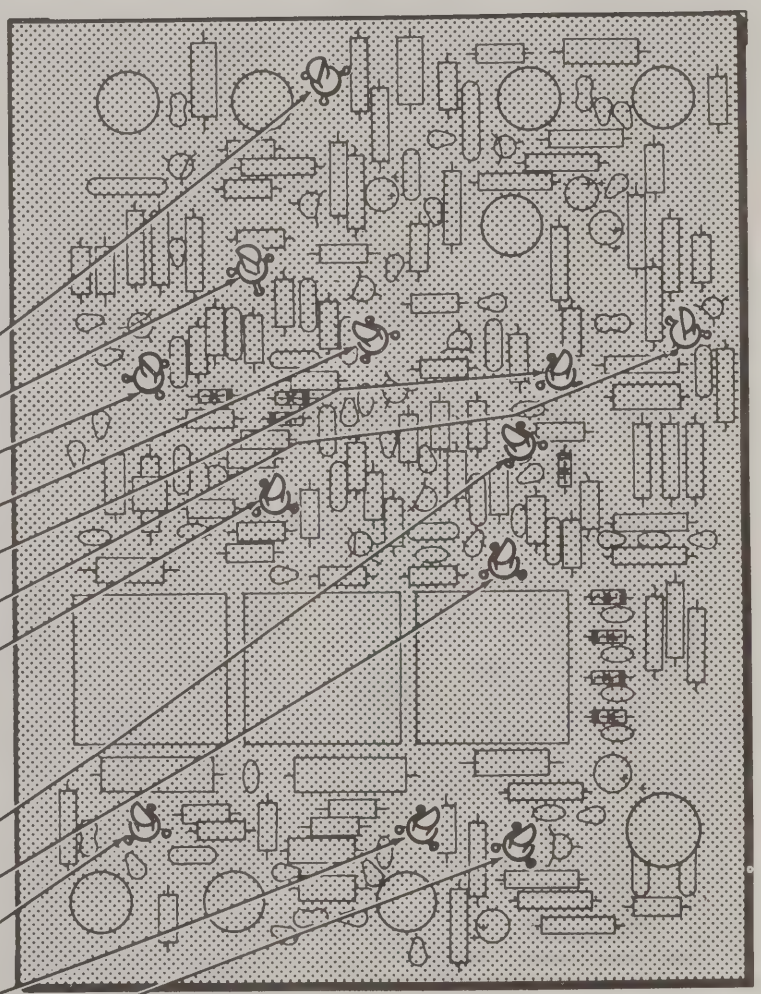
( ) 2N3393 transistor at Q405.

( ) 2N3393 transistor at Q410.

( ) 2N3393 transistor at Q411.

( ) 2N3393 transistor at Q403.

( ) Check to see that the leads of each transistor have been installed properly.

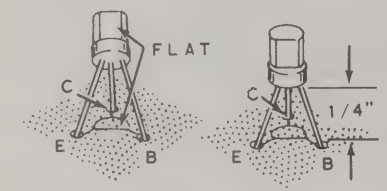


PROCEED TO PICTORIAL 1-4.

PICTORIAL 1-3

START

NOTE: When installing transistors in the following steps, be sure to position the E, B, and C leads of each transistor in the corresponding E, B, and C holes of the circuit board. Position the transistor over its outline and 1/4" above the circuit board. Solder all three connections and cut off the excess lead lengths as each transistor is installed.



Install X29A829 transistors (#417-201) at the following locations.

( ) X29A829 transistor at Q408.

( ) X29A829 transistor at Q412.

( ) X29A829 transistor at Q409.

( ) X29A829 transistor at Q418.

( ) X29A829 transistor at Q415.

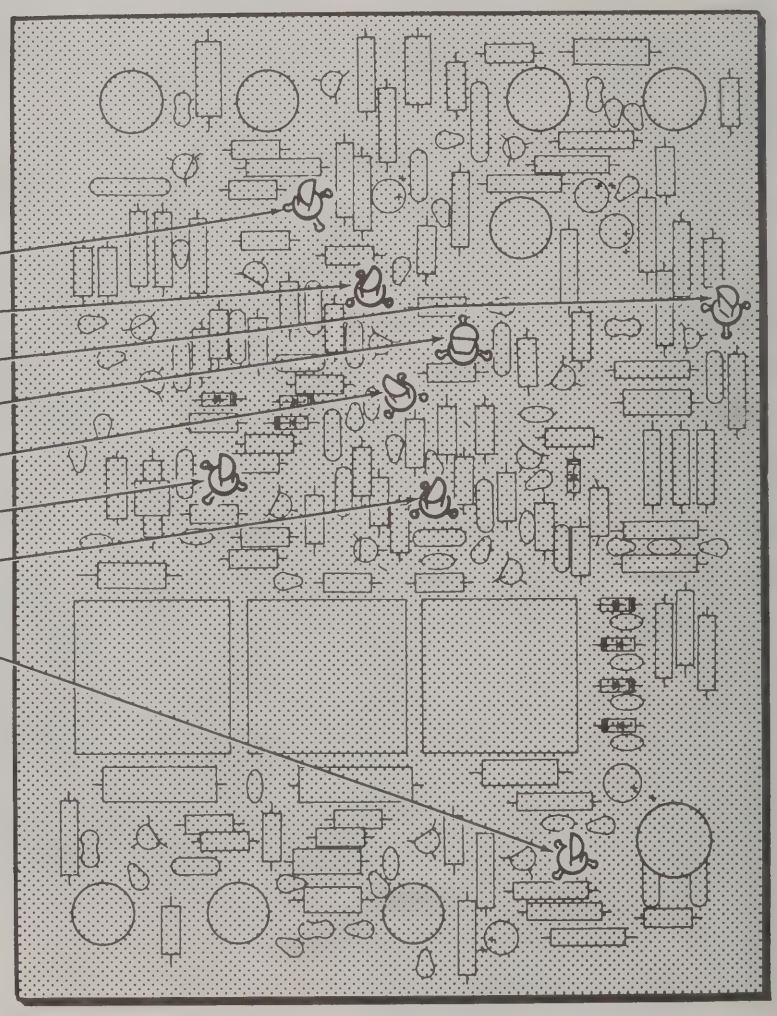
( ) X29A829 transistor at Q413.

( ) X29A829 transistor at Q417.

( ) X29A829 transistor at Q404.

( ) Check to see that the leads of each transistor have been installed properly. There should now be twenty transistors installed on this circuit board. If not, check the steps carefully to see if some were missed.

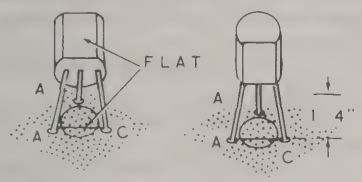
PROCEED TO PICTORIAL 1-5.



PICTORIAL 1-4

START

NOTE: When you install the MSD6101 dual diodes (#56-614) in the following steps, align the flat of the diode with the flat of the outline on the circuit board. Insert the end lead of the diode into hole C and the remaining leads into holes A. Position the diodes 1/4" above the circuit board. Solder all three connections and cut off the excess lead lengths as each diode is installed.



( ) Dual diode #56-614 at D427.

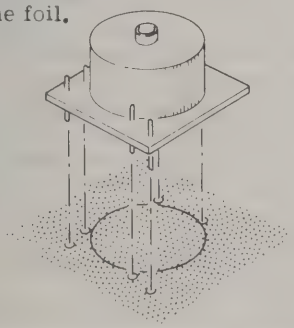
( ) Dual diode #56-614 at D428.

( ) Dual diode #56-614 at D422.

( ) Dual diode #56-614 at D429.

( ) Check to see that the leads of each diode have been positioned properly.

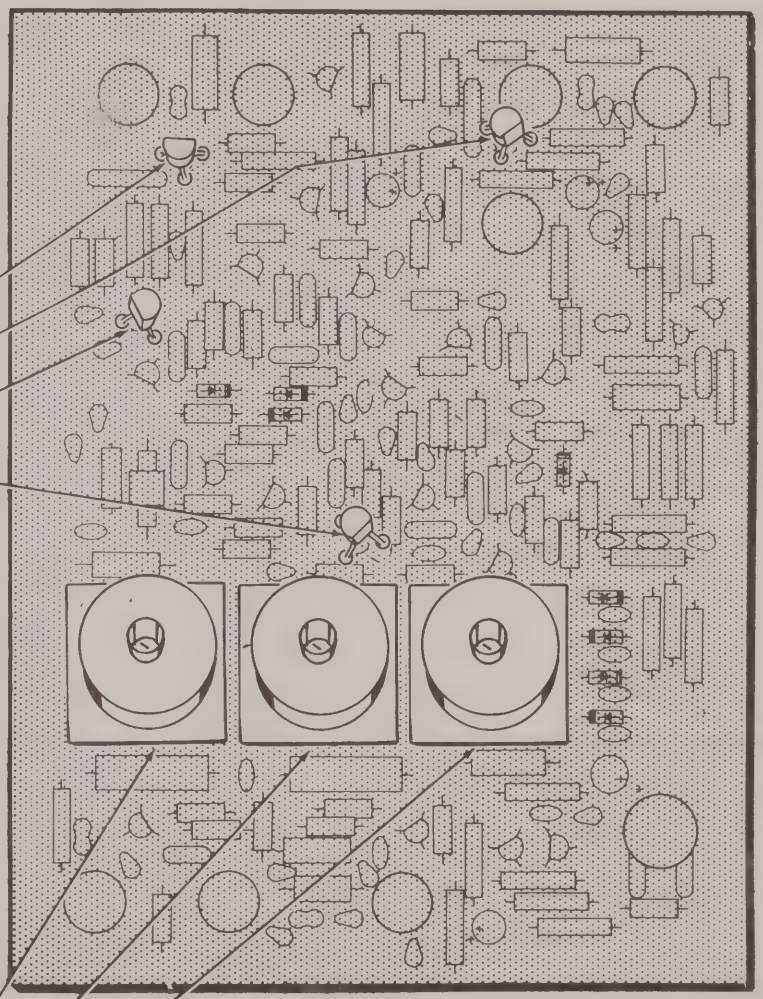
NOTE: Install each of the following coils by first lining up its lugs with the holes in the circuit board. Press the coil in place and solder each lug to the foil.



( ) 19 kHz amplifier coil (#40-786).

( ) 19 kHz doubler coil (#40-791).

( ) 38 kHz oscillator coil (#40-792).



PROCEED TO PICTORIAL 1-6.

PICTORIAL 1-5

HEATHKIT®

START

( ) 3300 pF polystyrene.

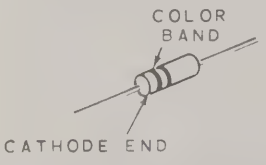
( ) 300 pF mica.

( ) .22 µF Mylar.

( ) .047 µF Mylar.

( ) .047 µF Mylar.

NOTE: When installing diodes, be sure to position the cathode end as shown. The cathode end is the banded end.



( ) 1N191 diode (brown-white-brown) at D431.

( ) 1N191 diode (brown-white-brown) at D421.

( ) 1N191 diode (brown-white-brown) at D430.

( ) Solder all connections and cut off the excess lead lengths.

( ) 1200 pF polystyrene.

( ) 100 pF disc.

( ) 2 mH RF choke (#45-47).

( ) 1800 pF polystyrene.

( ) .01 µF Mylar.

( ) 33 pF disc.

( ) 8200 pF polystyrene.

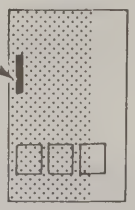
( ) 200 pF mica.

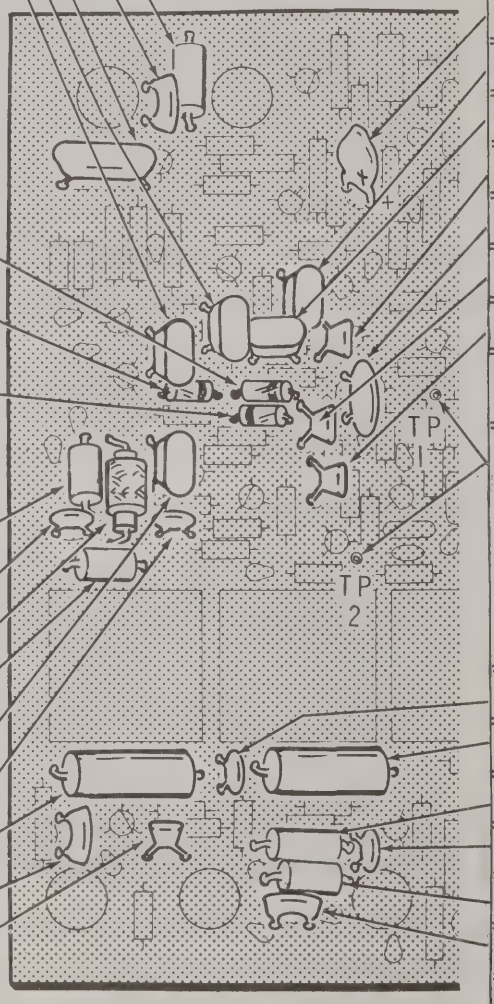
( ) .01 µF Mylar.

( ) Solder all connections and cut off the excess lead lengths.

IDENTIFICATION DRAWING

PART NUMBER





CONTINUE

NOTE: When installing electrolytic capacitors, be sure to position the positive (+) lead in the positive (+) marked hole of the circuit board.

( ) 10 µF electrolytic.

( ) .1 µF Mylar.

( ) .1 µF Mylar.

( ) .01 µF Mylar.

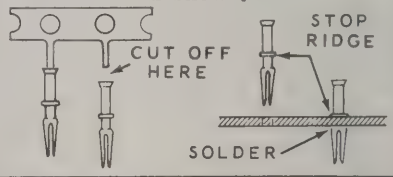
( ) .02 µF disc.

( ) .01 µF Mylar.

( ) .01 µF Mylar.

( ) Solder all connections and cut off the excess lead lengths.

( ) Install connector pins at TP1 and TP2 as shown.



( ) 100 pF disc.

( ) 10,000 pF polystyrene.

( ) 1800 pF polystyrene.

( ) 470 pF disc.

( ) 1000 pF polystyrene.

( ) 680 pF mica.

( ) Solder all connections and cut off the excess lead lengths.

PROCEED TO PICTORIAL 1-7.

PICTORIAL 1-6

IDENTIFICATION DRAWING

PART NUMBER

START

( ) 1800 pF polystyrene.

( ) .22 μF Mylar.

( ) .047 μF Mylar.

( ) .1 μF Mylar.

( ) .47 μF disc.

( ) .005 μF disc.

( ) .1 μF Mylar.

( ) .1 μF Mylar.

( ) Solder all connections and cut off the excess lead lengths.

( ) .001 μF disc.

( ) 1N191 diode (brown-white-brown) at D425. Note the banded end.

( ) 1N191 diode (brown-white-brown) at D426.

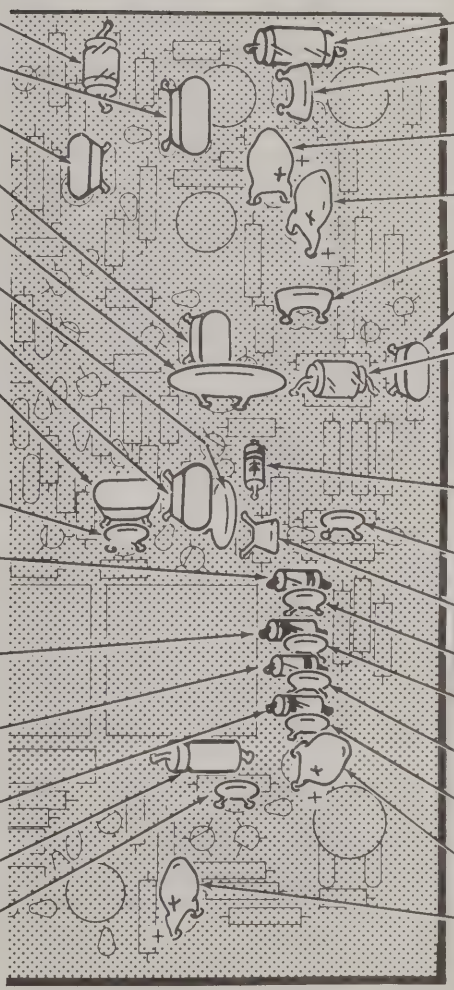
( ) 1N191 diode (brown-white-brown at D423.

( ) 1N191 diode (brown-white-brown) at D424.

( ) 2700 pF polystyrene.

( ) 100 pF disc.

( ) Solder all connections and cut off the excess lead lengths.



CONTINUE

( ) 3300 pF polystyrene.

( ) 300 pF mica.

( ) 10 μF electrolytic. Note positive (+) lead.

( ) 10 μF electrolytic.

( ) 680 pF mica.

( ) .047 μF Mylar.

( ) 1800 pF polystyrene.

( ) Solder all connections and cut off the excess lead lengths.

( ) 1N191 diode (brown-white-brown).

( ) .005 μF disc.

( ) .01 μF Mylar.

( ) 470 pF disc.

( ) 470 pF disc.

( ) 470 pF disc.

( ) 470 pF disc.

( ) 47 μF electrolytic.

( ) 10 μF electrolytic.

( ) Solder all connections and cut off the excess lead lengths.

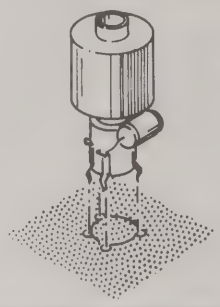
PROCEED TO PICTORIAL 1-8

PICTORIAL 1-7

START

NOTE: Install each of the following components by first lining up its lugs with the holes in the circuit board. Press the component firmly in place and solder each lug to the foil.

( ) 70 mH coil (#40-790).



( ) 19 kHz trap coil (#40-788).

( ) 70 mH coil (#40-790).

( ) 19 kHz trap coil (#40-788).

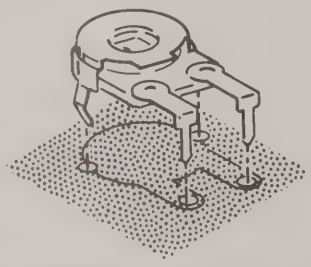
( ) 70 mH coil (#40-790).

( ) 67 kHz trap coil (#40-787).

( ) 53 kHz low pass coil (#40-789).

( ) 67 kHz trap coil (#40-787).

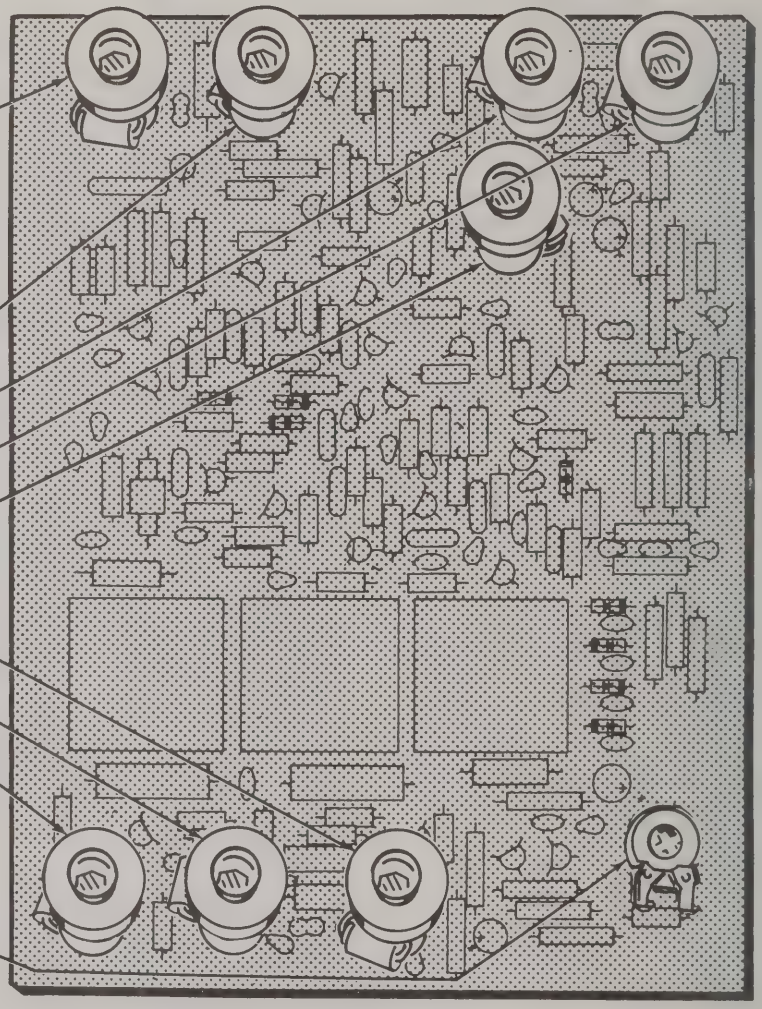
( ) 750 Ω control (#10-155).



This completes the assembly of the multiplex circuit board. Make a good visual inspection to make sure the electrolytic capacitors, diodes, and transistors have been installed properly. Be sure all connections are soldered and that no solder bridges exist between foils.

( ) Set the multiplex circuit board aside until called for later in the assembly steps.

FINISH



PICTORIAL 1-8

FM CIRCUIT BOARD

PARTS LIST

Unpack the package marked 2 and check each part against the following Parts List. The numbers in parentheses are keyed to the number on the FM Circuit Board Parts Pictorial (fold-out from Page 19). Any part that is packaged in an individual envelope should be placed back in its envelope until it is called for in a step.

PART No.	PARTS Per Kit	DESCRIPTION
RESISTORS		
1/2 Watt 1% (precision)		
(1)2-111	1	400 Ω
2-181	1	5490 Ω (5.49 k)
2-50	1	10 kΩ
1/2 Watt 5% (low-noise)		
4-55	1	33 Ω (orange-orange-black)
4-56	1	47 Ω (yellow-violet-black)
4-8	1	82 Ω (gray-red-black)
4-57	7	100 Ω (brown-black-brown)
4-58	1	150 Ω (brown-green-brown)
4-59	2	220 Ω (red-red-brown)
4-12	2	390 Ω (orange-white-brown)
4-60	3	470 Ω (yellow-violet-brown)
4-13	1	510 Ω (green-brown-brown)
4-61	1	560 Ω (green-blue-brown)
4-14	2	620 Ω (blue-red-brown)
4-62	1	820 Ω (gray-red-brown)
4-15	5	1000 Ω (brown-black-red)
4-41	2	1500 Ω (brown-green-red)
Resistors 1/2 Watt 5% (low-noise) (cont'd.)		
4-17	4	2200 Ω (red-red-red)
4-65	1	2400 Ω (red-yellow-red)
4-63	1	2700 Ω (red-violet-red)
4-18	3	3300 Ω (orange-orange-red)
4-20	2	4700 Ω (yellow-violet-red)
4-54	4	5600 Ω (green-blue-red)
4-37	3	6800 Ω (blue-gray-red)
4-21	1	8200 Ω (gray-red-red)
4-22	6	10 kΩ (brown-black-orange)
4-25	2	27 kΩ (red-violet-orange)
4-27	2	47 kΩ (yellow-violet-orange)
4-64	2	68 kΩ (blue-gray-orange)
4-45	1	82 kΩ (gray-red-orange)
4-34	3	100 kΩ (brown-black-yellow)
4-35	2	180 kΩ (brown-gray-yellow)
4-6	2	1 MΩ (brown-black-green)
4-66	2	1.2 MΩ (brown-red-green)
4-46	2	1.5 MΩ (brown-green-green)
Other Resistor		
(2)1-17-1	2	100 Ω 1 watt (brown-black-brown)

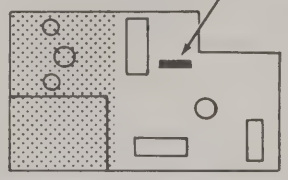
PART No.	PARTS Per Kit	DESCRIPTION
CAPACITORS		
Mica		
(3)20-102	2	100 pF
20-139	1	330 pF
Disc		
(4)21-78	1	5 pF
21-82	9	.02 μF
21-48	2	.05 μF
Mylar*		
(5)27-74	12	.01 μF
27-47	6	.1 μF
27-85	1	.22 μF
Electrolytic		
(6)25-220	4	10 μF tantalum
25-223	3	47 μF tantalum
(7)25-117	2	100 μF vertical
25-148	2	1000 μF 15 V vertical
25-164	1	1000 μF 25 V vertical
(8)25-146	1	100 μF tubular
25-175	1	250 μF tubular
25-154	1	2500 μF tubular

PART No.	PARTS Per Kit	DESCRIPTION
TRANSISTORS - INTEGRATED CIRCUITS - DIODES		
NOTE: Transistors will be marked with either the part number or transistor type number.		
(9)417-83	2	L842 transistor
417-91	4	2N5232A transistor
417-118	2	2N3393 transistor
417-201	5	X29A829 transistor
(10)417-133	2	40245 transistor
(11)417-175	4	TA2911 transistor
(12)417-123	2	Integrated circuit (CA3012)
(13)56-26	7	1N191 diode (brown-white-brown)
(14)56-36	1	Zener diode (16.1 V)
(15)57-27	2	Silicon diode
GENERAL		
(16)40-583	1	10 μH peaking coil (brown-black-black)
(17)60-4	1	SPDT slide switch
(18)53-11	1	Ratio detector transformer
(19)250-56	2	6-32 x 1/4" screw
(20)404-383	2	10.7 MHz crystal filter
344-52	1	Red hookup wire
490-5	1	Plastic nut starter
ITEMS FROM PACK 3		
(21)110-39	1	FM tuning unit
85-300-2	1	FM circuit board

STEP-BY-STEP ASSEMBLY

( ) Locate the FM circuit board and position it as shown in Pictorial 2-1. Then complete the steps on Pages 19 through 29.

PART NUMBER



IDENTIFICATION DRAWING

START

( ) 100 Ω 5% (brown-black-brown).

( ) 100 Ω 5% (brown-black-brown).

( ) 100 Ω 5% (brown-black-brown).

( ) 6800 Ω 5% (blue-gray-red).

( ) 27 kΩ 5% (red-violet-orange).

( ) 1.2 MΩ 5% (brown-red-green).

( ) 1 MΩ 5% (brown-black-green).

( ) 1000 Ω 5% (brown-black-red).

( ) 180 kΩ 5% (brown-gray-yellow).

( ) Solder all connections and cut off the excess lead lengths.

( ) 180 kΩ 5% (brown-gray-yellow).

( ) 1000 Ω 5% (brown-black-red).

( ) 1 MΩ 5% (brown-black-green).

( ) 1.2 MΩ 5% (brown-red-green).

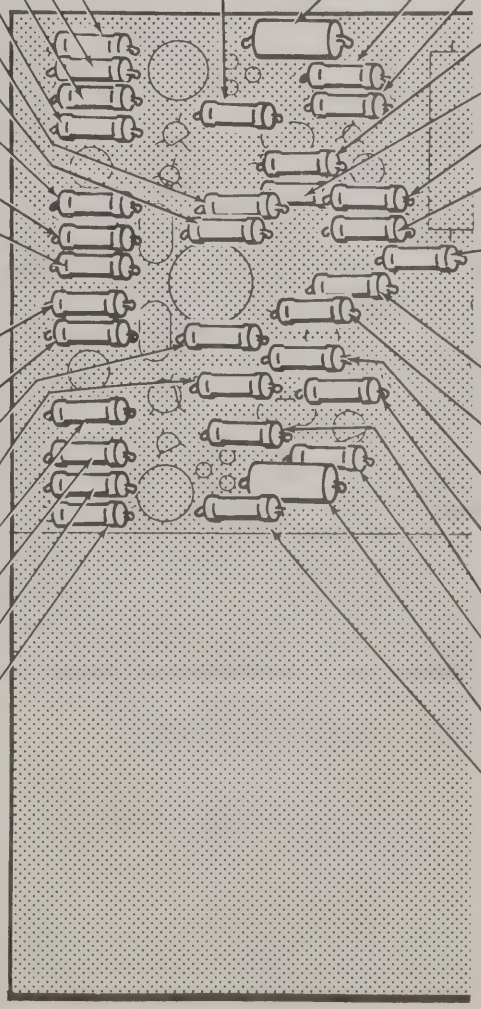
( ) 27 kΩ 5% (red-violet-orange).

( ) 100 Ω 5% (brown-black-brown).

( ) 100 Ω 5% (brown-black-brown).

( ) 100 Ω 5% (brown-black-brown).

( ) Solder all connections and cut off the excess lead lengths.



CONTINUE

( ) 4700 Ω 5% (yellow-violet-red).

( ) 100 Ω 1 watt (brown-black-brown).

( ) 2200 Ω 5% (red-red-red).

( ) 1.5 MΩ 5% (brown-green-green).

( ) 5600 Ω 5% (green-blue-red).

( ) 5600 Ω 5% (green-blue-red).

( ) 3300 Ω 5% (orange-orange-red).

( ) 2400 Ω 5% (red-yellow-red).

( ) 220 Ω 5% (red-red-brown).

( ) Solder all connections and cut off the excess lead lengths.

( ) 3300 Ω 5% (orange-orange-red).

( ) 5600 Ω 5% (green-blue-red).

( ) 5600 Ω 5% (green-blue-red).

( ) 1.5 MΩ 5% (brown-green-green).

( ) 4700 Ω 5% (yellow-violet-red).

( ) 2200 Ω 5% (red-red-red).

( ) 100 Ω 1 watt (brown-black-brown).

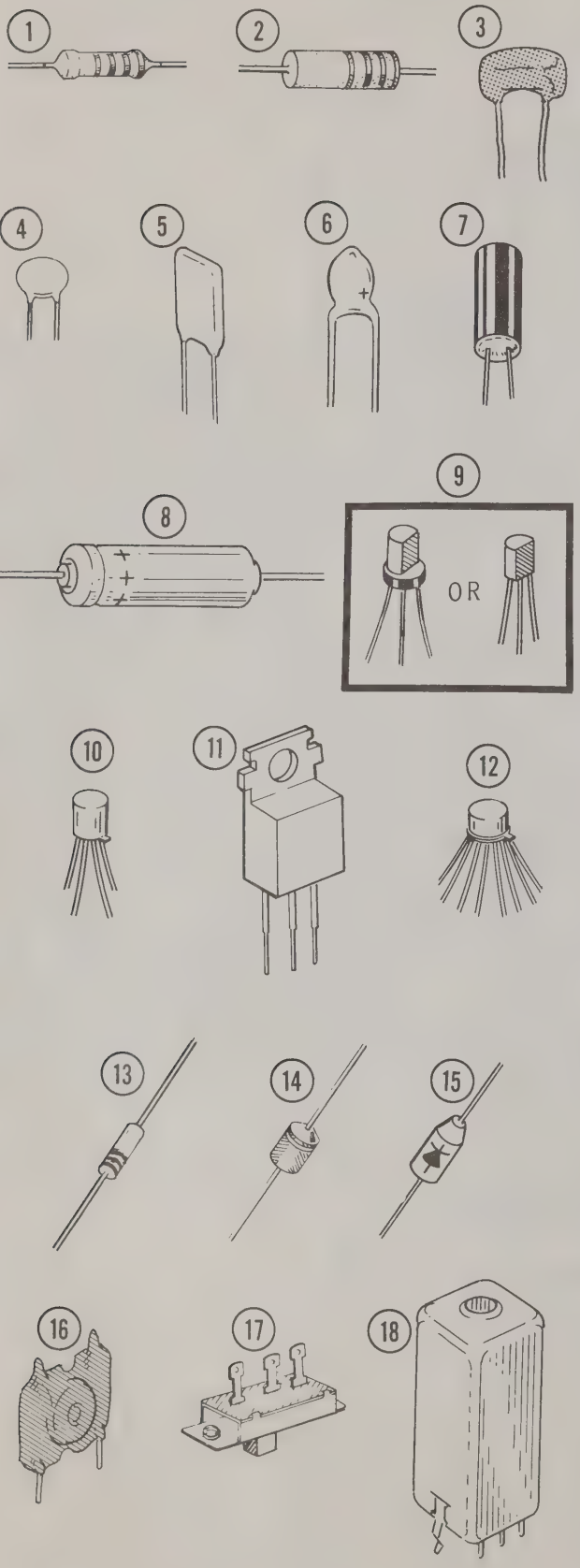
( ) 6800 Ω 5% (blue-gray-red).

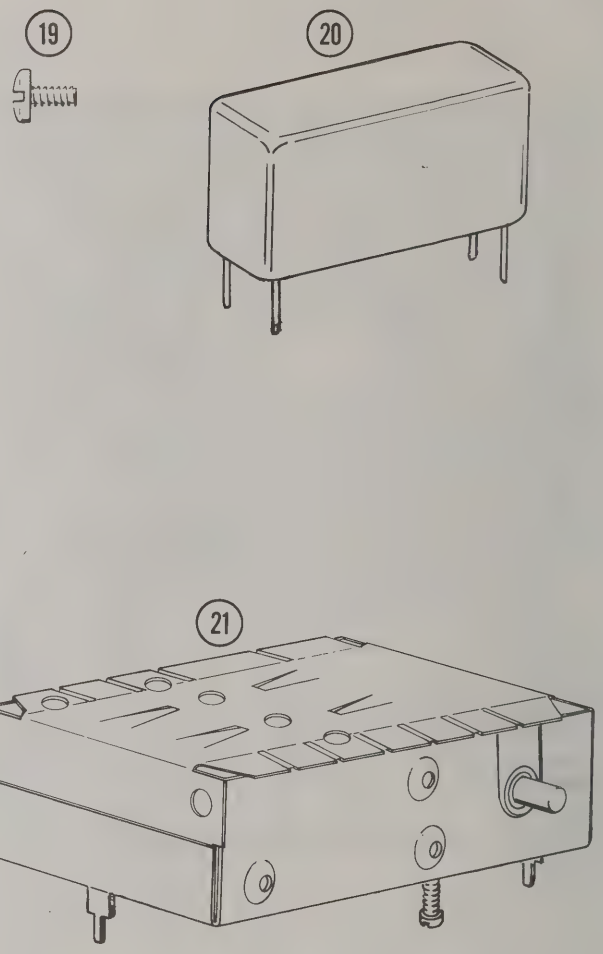
( ) Solder all connections and cut off the excess lead lengths.

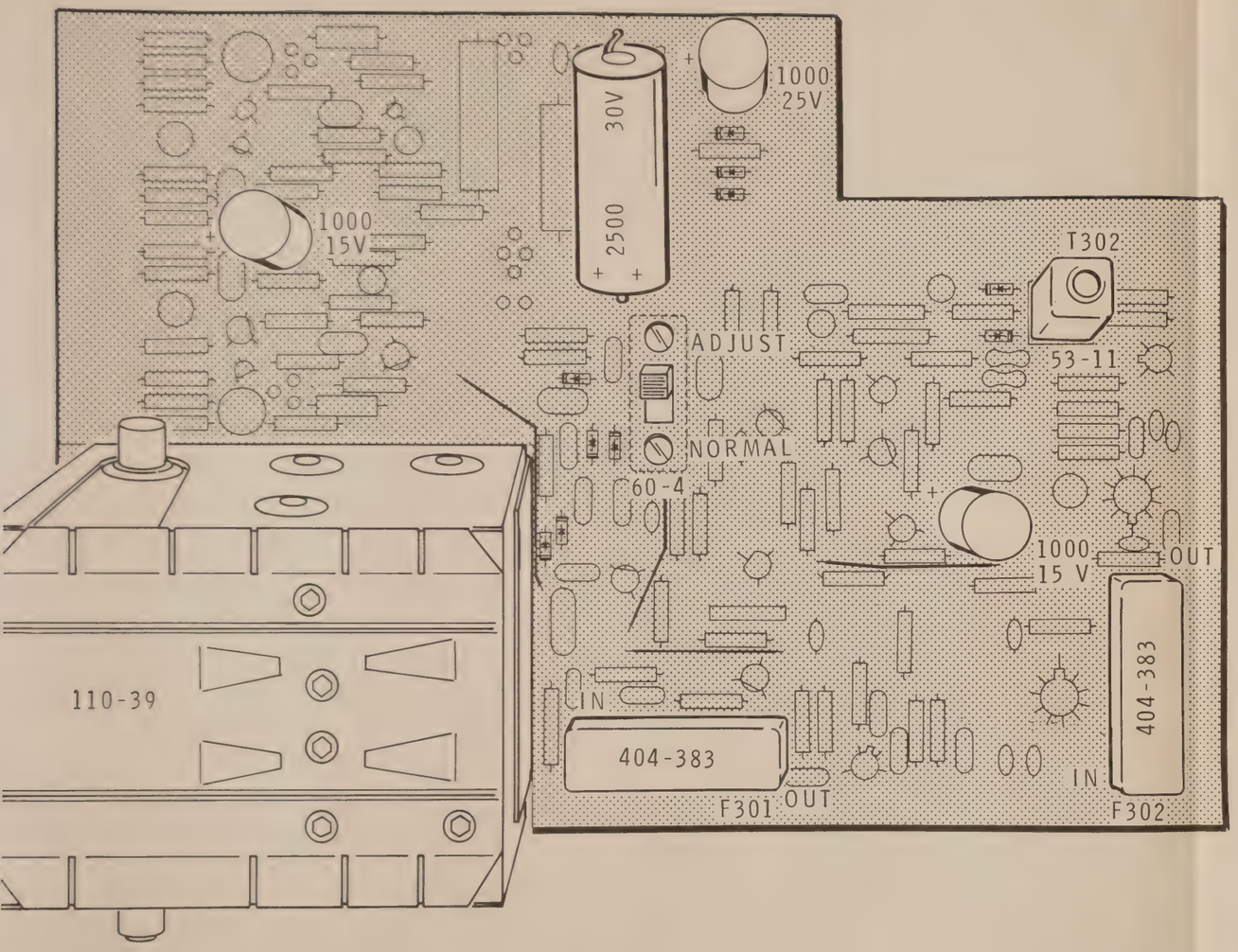
PROCEED TO PICTORIAL 2-2

PICTORIAL 2-1

FM CIRCUIT BOARD PARTS PICTORIAL

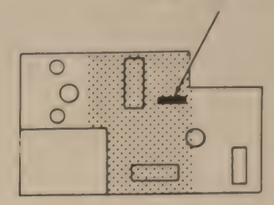






PICTORIAL 2-12

PART NUMBER



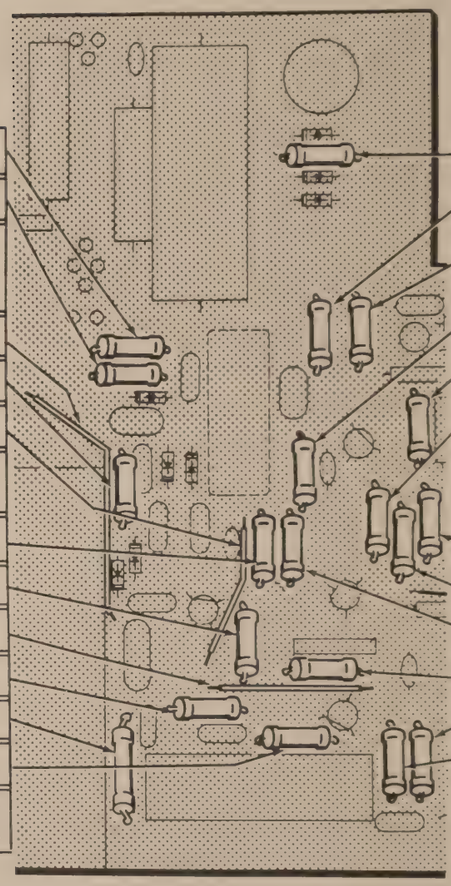
IDENTIFICATION DRAWING

START

- ( ) 82 Ω 5% (gray-red-black).
- ( ) 820 Ω 5% (gray-red-brown).

NOTE: When installing the following hookup wires, remove 1/4" of insulation from each end.

- ( ) 2-3/4" red wire.
- ( ) 10 kΩ 5% (brown-black-orange).
- ( ) 1-3/4" red wire.
- ( ) Solder all connections and cut off the excess lead lengths.
- ( ) 68 kΩ 5% (blue-gray-orange).
- ( ) 47 Ω 5% (yellow-violet-black).
- ( ) 1-7/8" red wire.
- ( ) 560 Ω 5% (green-blue-brown).
- ( ) 400 Ω 1%.
- ( ) 10 kΩ 5% (brown-black-orange).
- ( ) Solder all connections and cut off the excess lead lengths.

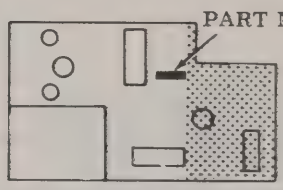


CONTINUE

- ( ) 470 Ω 5% (yellow-violet-brown).
- ( ) 47 kΩ 5% (yellow-violet-orange).
- ( ) 10 kΩ 5% (brown-black-orange).
- ( ) 100 kΩ 5% (brown-black-yellow).
- ( ) 82 kΩ 5% (gray-red-orange).
- ( ) 8200 Ω 5% (gray-red-red).
- ( ) Solder all connections and cut off the excess lead lengths.
- ( ) 1500 Ω 5% (brown-green-red).
- ( ) 390 Ω 5% (orange-white-brown).
- ( ) 6800 Ω 5% (blue-gray-red).
- ( ) 1000 Ω 5% (brown-black-red).
- ( ) 10 kΩ 5% (brown-black-orange).
- ( ) 620 Ω 5% (blue-red-brown).
- ( ) Solder all connections and cut off the excess lead lengths.

PROCEED TO PICTORIAL 2-3.

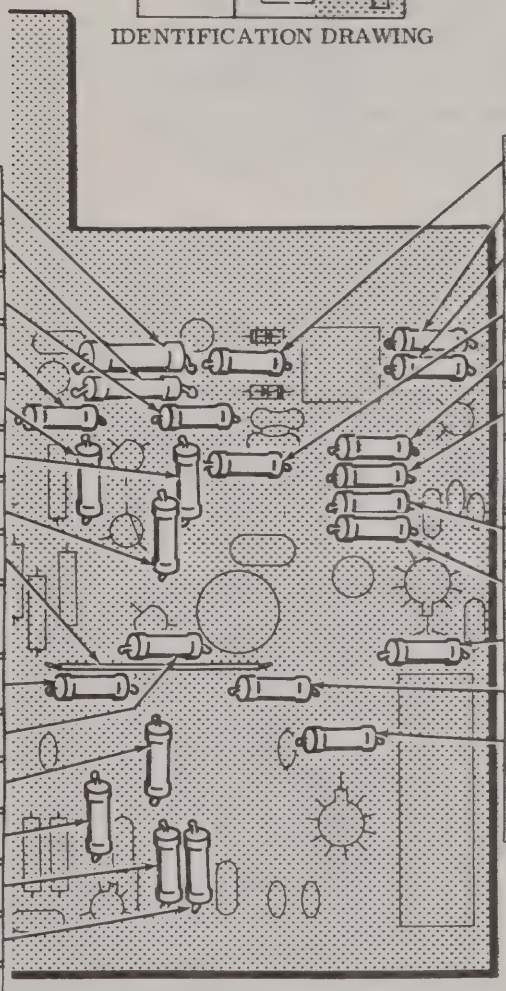
PICTORIAL 2-2



IDENTIFICATION DRAWING

START

( ) 5490 Ω 1% (5.49 k).
( ) 10 kΩ 1%.
( ) 1500 Ω 5% (brown-green-red).
( ) 3300 Ω 5% (orange-orange-red).
( ) 100 kΩ 5% (brown-black-yellow).
( ) 2200 Ω 5% (red-red-red).
( ) 100 Ω 5% (brown-black-brown).
( ) 2-1/8" red wire.
( ) Solder all connections and cut off the excess lead lengths.
( ) 390 Ω 5% (orange-white-brown).
( ) 100 kΩ 5% (brown-black-yellow).
( ) 150 Ω 5% (brown-green-brown).
( ) 1000 Ω 5% (brown-black-red).
( ) 2700 Ω 5% (red-violet-red).
( ) 47 kΩ 5% (yellow-violet-orange).
( ) Solder all connections and cut off the excess lead lengths.

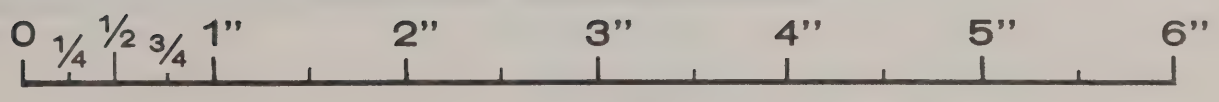


CONTINUE

( ) 1000 Ω 5% (brown-black-red).
( ) 470 Ω 5% (yellow-violet-brown).
( ) 470 Ω 5% (yellow-violet-brown).
( ) 10 kΩ 5% (brown-black-orange).
( ) 220 Ω 5% (red-red-brown).
( ) 10 kΩ 5% (brown-black-orange).
( ) Solder all connections and cut off the excess lead lengths.
( ) 68 kΩ 5% (blue-gray-orange).
( ) 2200 Ω 5% (red-red-red).
( ) 620 Ω 5% (blue-red-brown).
( ) 33 Ω 5% (orange-orange-black).
( ) 510 Ω 5% (green-brown-brown).
( ) Solder all connections and cut off the excess lead lengths.

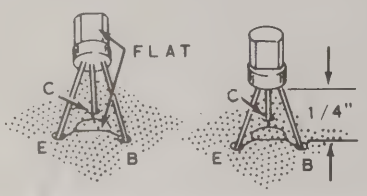
PROCEED TO PICTORIAL 2-4.

PICTORIAL 2-3



START

NOTE: When installing transistors in the following steps, be sure to position the E, B, and C leads of each transistor into the corresponding E, B, and C holes of the circuit board. Position each transistor over its outline and 1/4" above the circuit board. Solder all three connections and cut off the excess lead lengths as each transistor is installed.



Install X29A829 transistors (#417-201) at the following locations.

( ) X29A829 transistor at Q102R.

( ) X29A829 transistor at Q307.

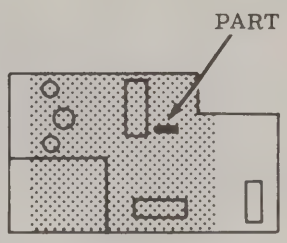
( ) X29A829 transistor at Q313.

( ) X29A829 transistor at Q314.

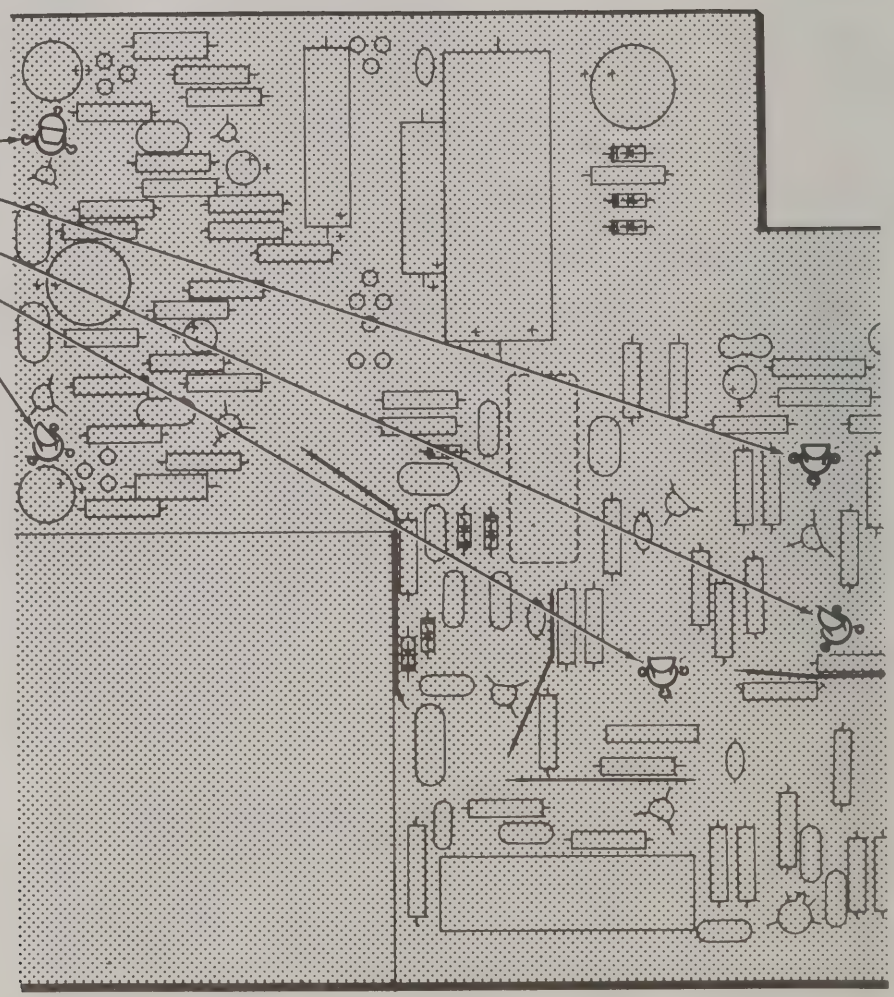
( ) X29A829 transistor at Q102L.

( ) Check to see that the leads of each transistor have been installed properly.

PROCEED TO PICTORIAL 2-5.



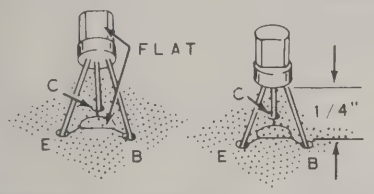
IDENTIFICATION DRAWING



PICTORIAL 2-4

START

NOTE: When installing transistors in the following steps, be sure to position the E, B, and C leads of each transistor into the corresponding E, B, and C holes of the circuit board. Position each transistor over its outline and 1/4" above the circuit board. Solder all three connections and cut off the excess lead lengths as each transistor is installed.



Install 2N5232A transistors (#417-91) at the following locations.

( ) 2N5232A transistor at Q101R.

( ) 2N5232A transistor at Q104L.

( ) 2N5232A transistor at Q101L.

( ) 2N5232A transistor at Q104R.

Install L842 transistors (#417-83) at the following locations. They are installed the same as the transistor above.

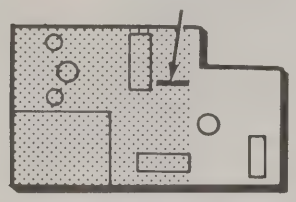
( ) L842 transistor at Q310.

( ) L842 transistor at Q309.

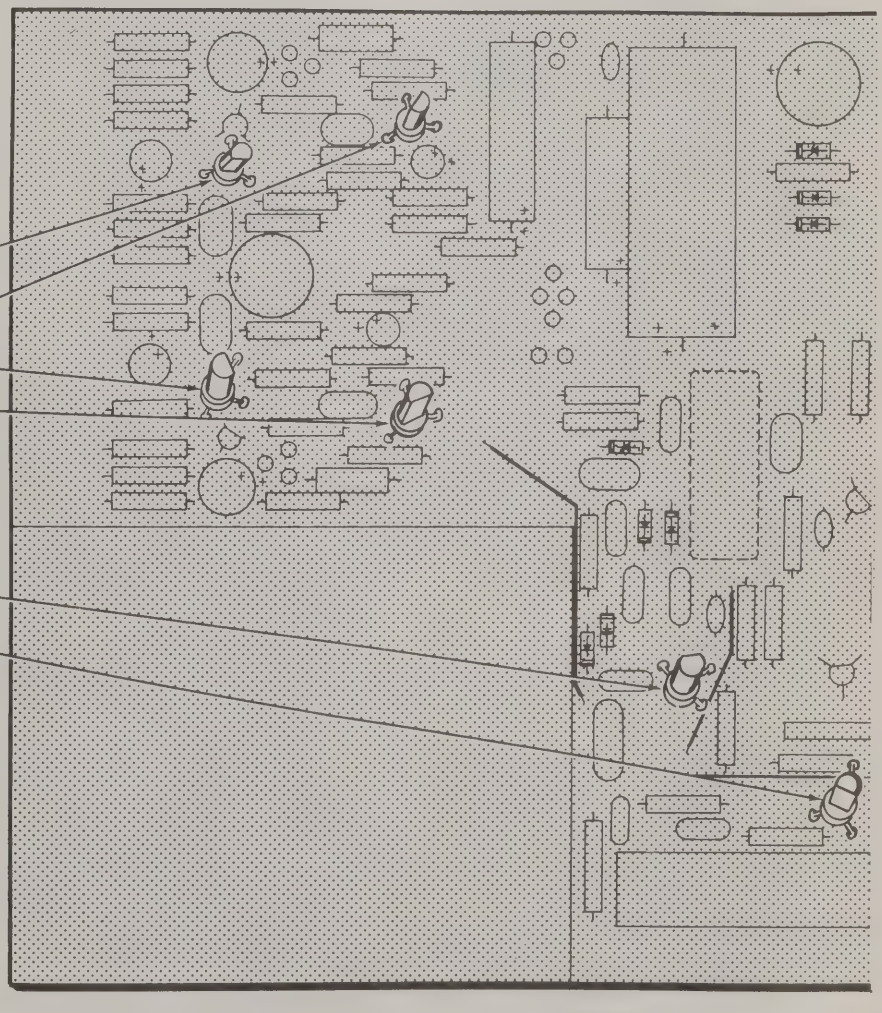
( ) Check to see that the leads of each transistor have been installed properly.

PROCEED TO PICTORIAL 2-6.

PART NUMBER



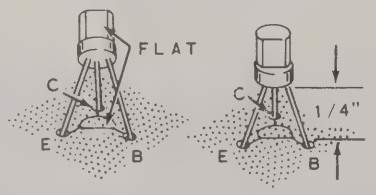
IDENTIFICATION DRAWING



PICTORIAL 2-5

START

NOTE: When installing the following two transistors, be sure to position the E, B, and C leads of each transistor into the corresponding E, B, and C holes of the circuit board. Position each transistor over its outlined and 1/4" above the circuit board. Solder all three connections and cut off the excess lead lengths as each transistor is installed.

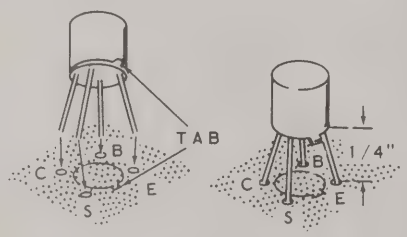


Install 2N3393 transistors (#417-118) at the following locations.

( ) 2N3393 transistor at Q308.

( ) 2N3393 transistors at Q312.

NOTE: When installing the following two transistors, be sure to position the E, B, C, and S leads of each transistor in the corresponding E, B, C and S holes of the circuit board. Position each transistor over its outline and 1/4" above the circuit board. Solder all four connections and cut off the excess lead lengths as each transistor is installed.



Install 40245 transistors (#417-133) at the following locations.

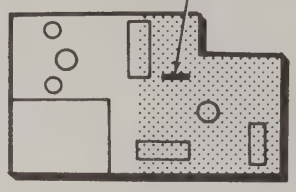
( ) 40245 transistor at Q306.

( ) 40245 transistor at Q305.

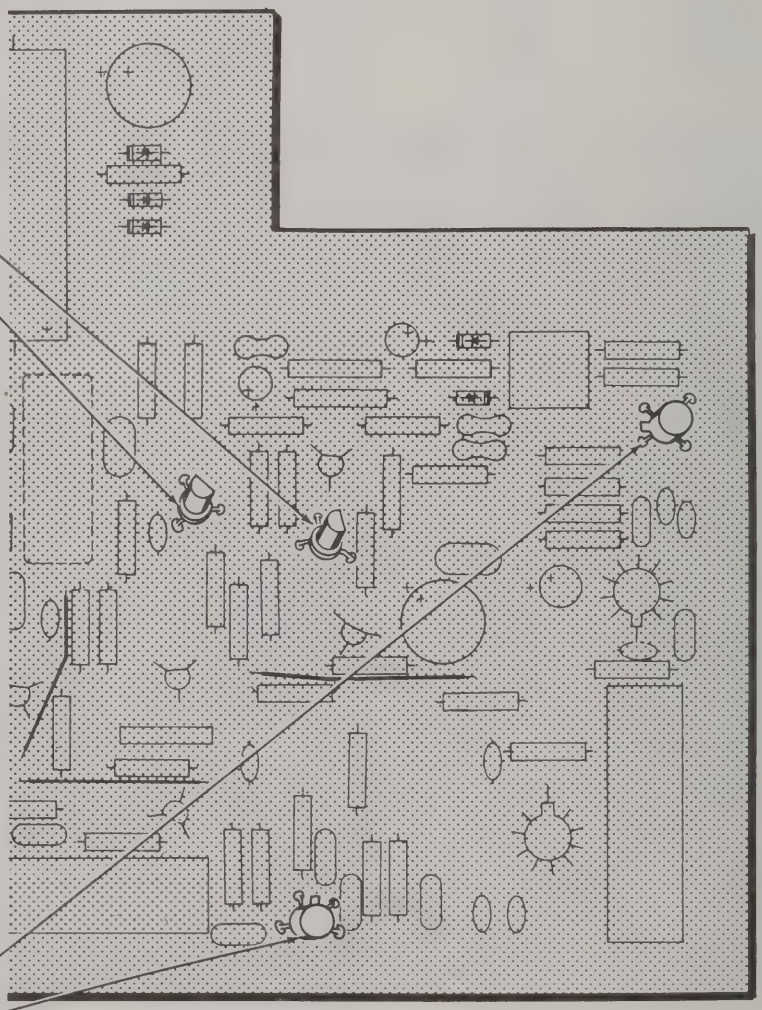
( ) Check to see that the leads of each transistor have been installed properly.

PROCEED TO PICTORIAL 2-7.

PART NUMBER



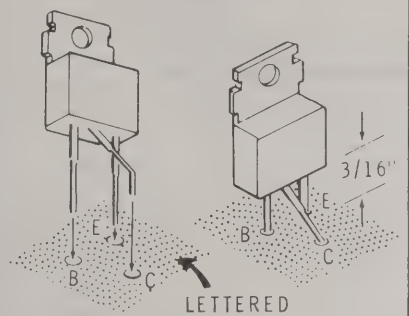
IDENTIFICATION DRAWING



PICTORIAL 2-6

START

NOTE: When installing transistors in the following steps, be sure to install the E, B, and C lugs of each transistor in the corresponding E, B, and C holes of the circuit board. Solder all three connections and cut off the excess lead lengths as each transistor is installed.



Install TA2911 transistors (#417-175) at the following locations.

( ) TA2911 transistor at Q103R.

( ) TA2911 transistor at Q503.

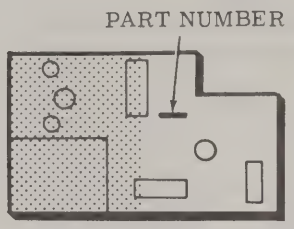
( ) TA2911 transistor at Q501.

( ) TA2911 transistor at Q103L.

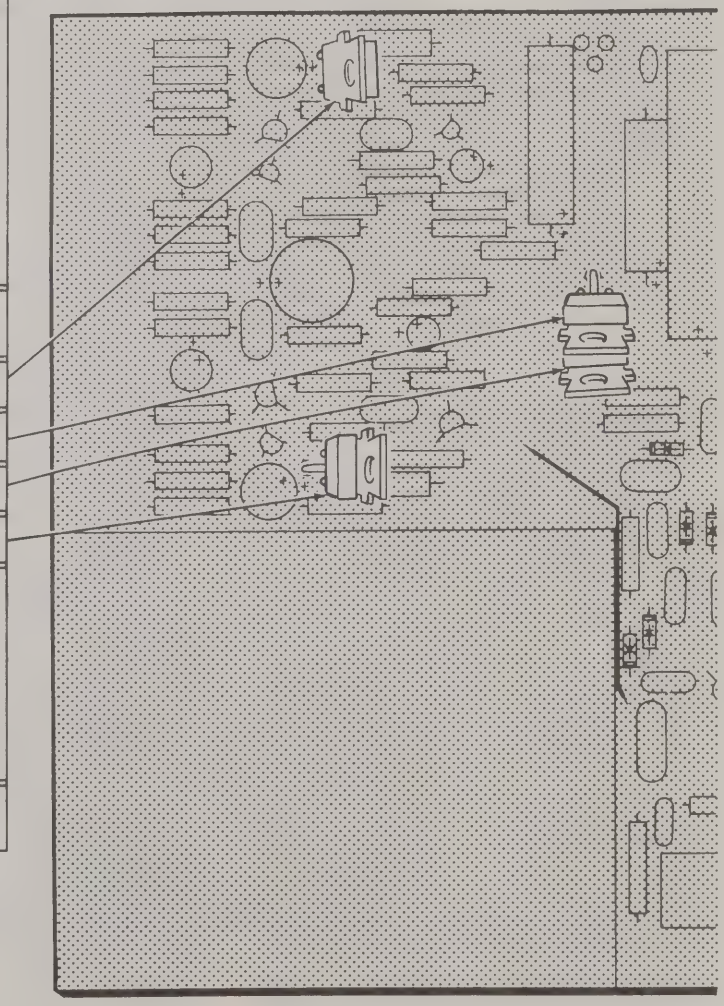
( ) Check to see that the lugs of each transistor have been installed properly. There should now be nineteen transistors installed on this circuit board. If not, check the steps carefully to see if some were missed.

NOTE: Transistor Q502 will be installed later.

PROCEED TO PICTORIAL 2-8.



IDENTIFICATION DRAWING

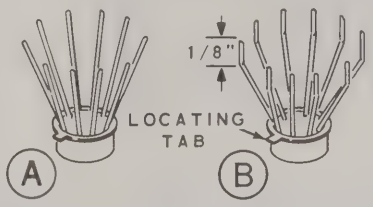


PICTORIAL 2-7

START

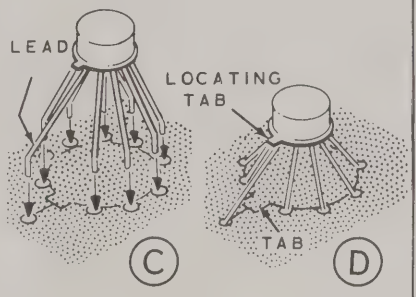
NOTE: Install the integrated circuits in the following manner, as shown:

(A) Bend all leads out to form a 3/4" circle.



(B) Bend the end of each lead so that it points straight up as shown.

(C) Line up the locating tab of the integrated circuit with the outline of the tab on the circuit board. Insert lead 10 (the one nearest the locating tab) into the hole at the tab and then insert the remaining leads into their correct holes.



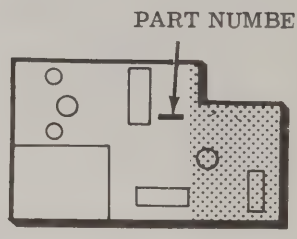
(D) Hold the integrated circuit in place and turn the circuit board over. First solder lead 10 to the foil and then solder the remaining nine leads. Cut off the excess lead lengths after soldering them.

( ) Integrated circuit CA3012 at IC-302.

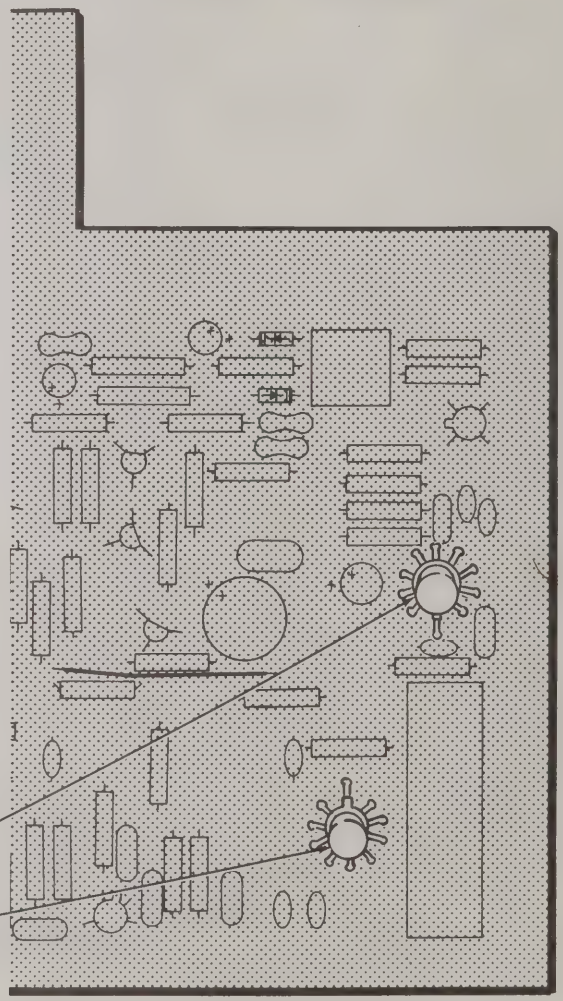
( ) Integrated circuit CA3012 at IC-301.

( ) Recheck the integrated circuits to make sure the leads were installed in the correct holes.

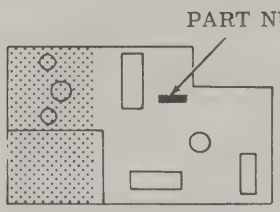
PROCEED TO PICTORIAL 2-9.



IDENTIFICATION DRAWING



PICTORIAL 2-8



IDENTIFICATION DRAWING

START

NOTE: When installing electrolytic capacitors, be sure to position the positive (+) marked lead in the positive (+) marked hole of the circuit board.

( ) 100 μF vertical electrolytic.

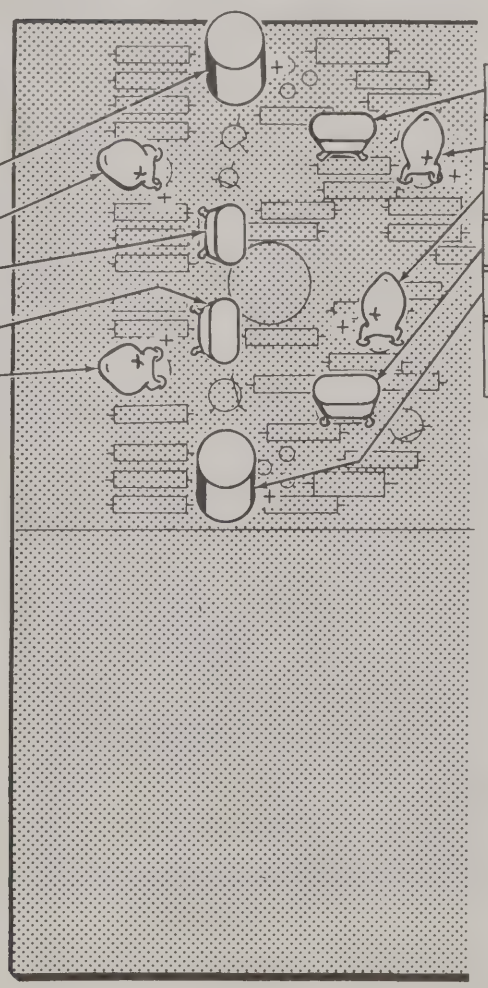
( ) 47 μF electrolytic.

( ) .1 μF Mylar.

( ) .1 μF Mylar.

( ) 47 μF electrolytic.

( ) Solder all connections and cut off the excess lead lengths.



CONTINUE

( ) .1 μF Mylar.

( ) 10 μF electrolytic.

( ) 10 μF electrolytic.

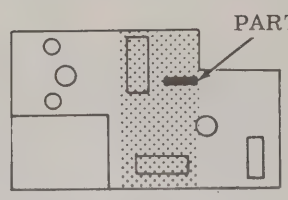
( ) .1 μF Mylar.

( ) 100 μF vertical electrolytic.

( ) Solder all connections and cut off the excess lead lengths.

PROCEED TO PICTORIAL 2-10.

PICTORIAL 2-9



IDENTIFICATION DRAWING

START

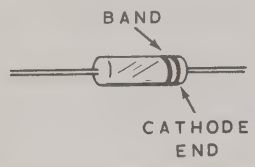
( ) .02 μF disc.

( ) 250 μF tubular electrolytic. Note the positive (+) lead.

( ) 100 μF tubular electrolytic.

( ) .01 μF Mylar.

NOTE: When installing diodes, be sure to position the cathode end as shown. The cathode end is the banded end.



( ) 1N191 diode (brown-white-brown).

( ) .1 μF Mylar.

( ) .01 μF Mylar.

( ) Solder all connections and cut off the excess lead lengths.

( ) 1N191 diode (brown-white-brown).

( ) 1N191 diode (brown-white-brown).

( ) 1N191 diode (brown-white-brown).

( ) 1N191 diode (brown-white-brown).

( ) .01 μF Mylar.

( ) .22 μF Mylar.

( ) 5 pF disc.

( ) Solder all connections and cut off the excess lead lengths.

CONTINUE

( ) Zener diode (#56-36).

( ) Silicon diode (#57-27).

( ) Silicon diode (#57-27).

( ) .1 μF Mylar.

( ) .02 μF disc.

( ) 330 pF mica.

( ) 10 μF electrolytic.

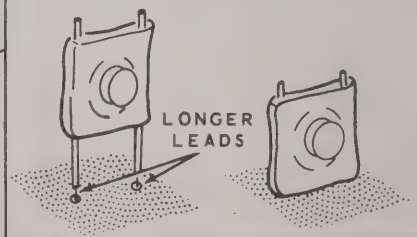
( ) Solder all connections and cut off the excess lead lengths.

( ) .01 μF Mylar.

( ) .01 μF Mylar.

( ) .02 μF disc.

( ) 10 μH peaking coil #40-583 (brown-black-black).



( ) .02 μF disc.

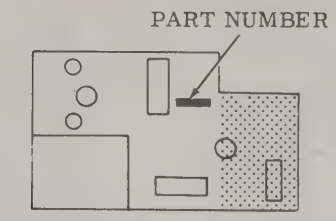
( ) .01 μF Mylar.

( ) .01 μF Mylar.

( ) Solder all connections and cut off the excess lead lengths.

PROCEED TO PICTORIAL 2-11.

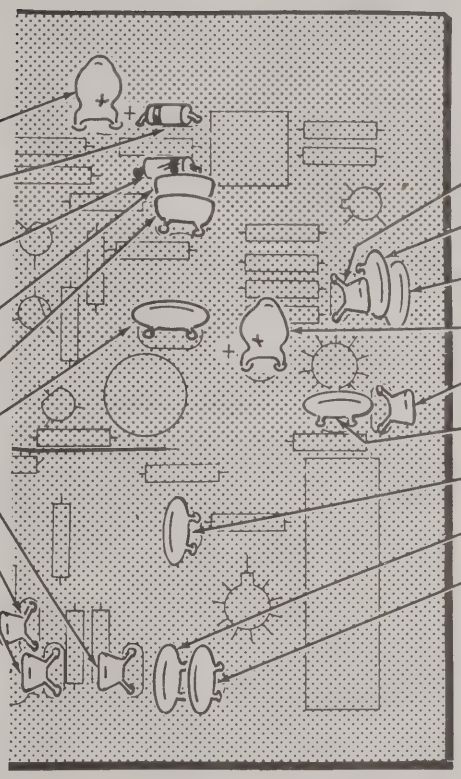
PICTORIAL 2-10



IDENTIFICATION DRAWING

START

- ( ) 10 μF electrolytic.
- ( ) 1N191 diode (brown-white-brown).
- ( ) 1N191 diode (brown-white-brown).
- ( ) 100 pF mica.
- ( ) 100 pF mica.
- ( ) .05 μF disc.
- ( ) .01 μF Mylar.
- ( ) .01 μF Mylar.
- ( ) .01 μF Mylar.
- ( ) Solder all connections and cut off the excess lead lengths.



CONTINUE

- ( ) .01 μF Mylar.
- ( ) .02 μF disc.
- ( ) .02 μF disc.
- ( ) 47 μF electrolytic.
- ( ) .01 μF Mylar.
- ( ) .05 μF disc.
- ( ) .02 μF disc.
- ( ) .02 μF disc.
- ( ) .02 μF disc.
- ( ) Solder all connections and cut off the excess lead lengths.

PROCEED TO PAGE 30.

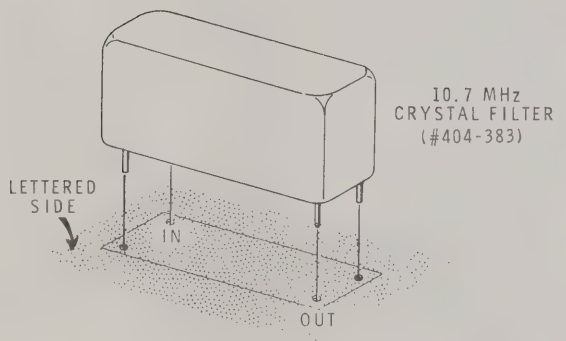
PICTORIAL 2-11

Refer to Pictorial 2-12 (fold-out from Page 20) for the following steps.

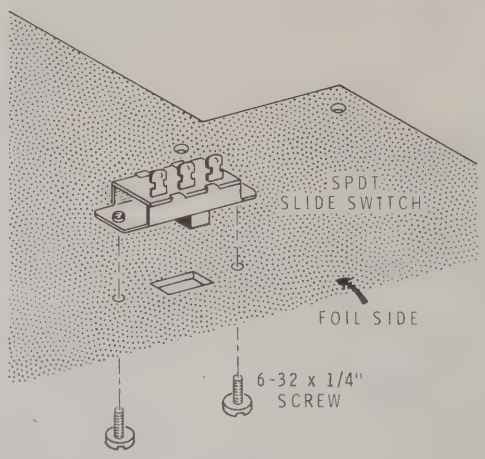
NOTE: Use the nut starter included in the kit to hold and start 4-40 and 6-32 nuts. Refer to the Kit Builders Guide for further information.

( ) Refer to Detail 2-12A, and install 10.7 MHz crystal filters (#404-383) at locations F301 and F302 on the circuit board. First match lugs marked IN and OUT on the filter with the same markings on the circuit board. Then push the filters in place against the circuit board.

( ) Solder the lugs of each filter to the circuit board and cut off the excess lead lengths.



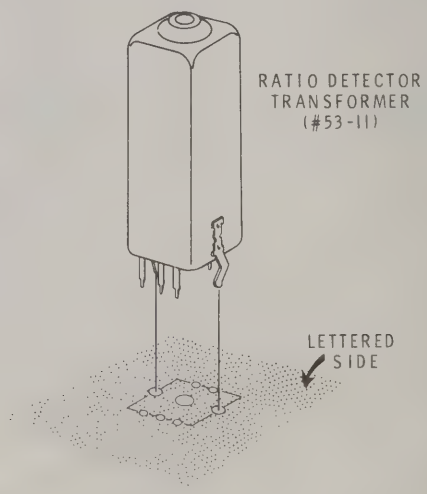
Detail 2-12A



Detail 2-12B

( ) Refer to Detail 2-12B and install the SPDT slide switch with 6-32 x 1/4" screws. Install this switch on the foil side of the circuit board and position it as shown.

( ) Refer to Detail 2-12C and install the ratio detector transformer (#53-11). Solder all seven pins to the foil. Cut off the pins as close to the foil as possible after soldering.



Detail 2-12C

CAUTION: The FM tuning unit that is installed in the next step was prealigned at the factory. Be very careful not to turn any of its adjusting screws.

( ) Refer to Detail 2-12D and install the FM tuning unit (#110-39). Insert the three mounting studs and the five tuner pins into the correct holes of the circuit board. Push the mounting studs tight against the circuit board and then solder the three mounting studs to the foil of the circuit board.

( ) Now solder the tuner pins to the foil of the circuit board. Cut off the pins as close to the foil as possible after soldering.

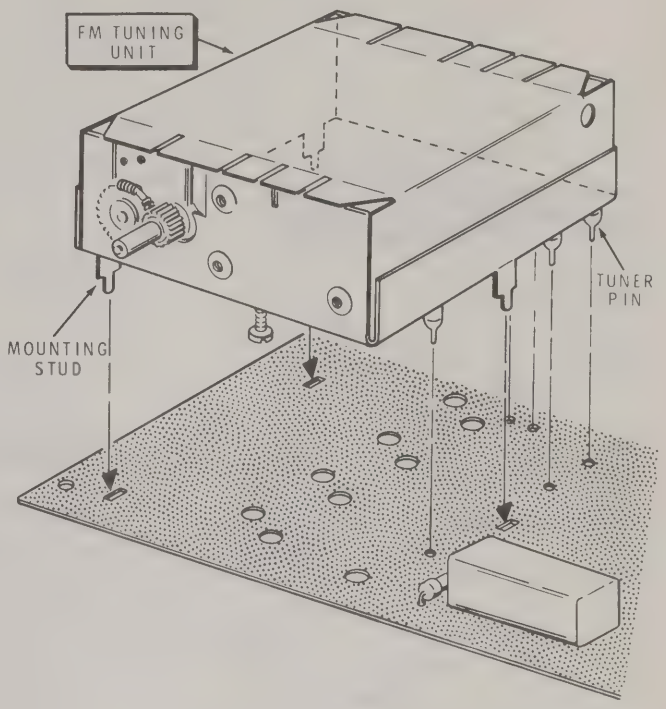
( ) Install the 1000 μF 25 V vertical electrolytic capacitor at the location shown.

( ) Install the two 1000 μF 15 V vertical electrolytic capacitors at the locations shown.

( ) Install the 2500 μF 30 V tubular electrolytic capacitor at the location shown.

( ) Solder the connections of these capacitors and cut off the excess lead lengths.

This completes the assembly of the FM circuit board except for transistor Q502 which will be installed later. Check it carefully to see that all connections are soldered, and that no solder bridges exist between foils. Be sure all excess lead lengths, excess pin lengths of the ratio detector transformer (#53-11), and the excess pin lengths of the tuner and IC's, have been cut off next to the foil.



Detail 2-12D

Save the remaining length of red hookup wire for later use.

( ) Set the FM circuit board aside until it is called for later.

CHASSIS

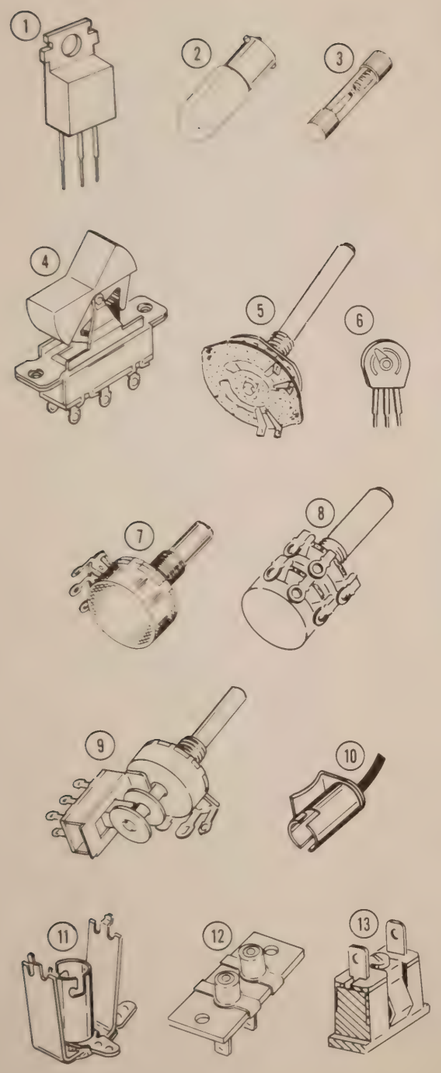
PARTS LIST

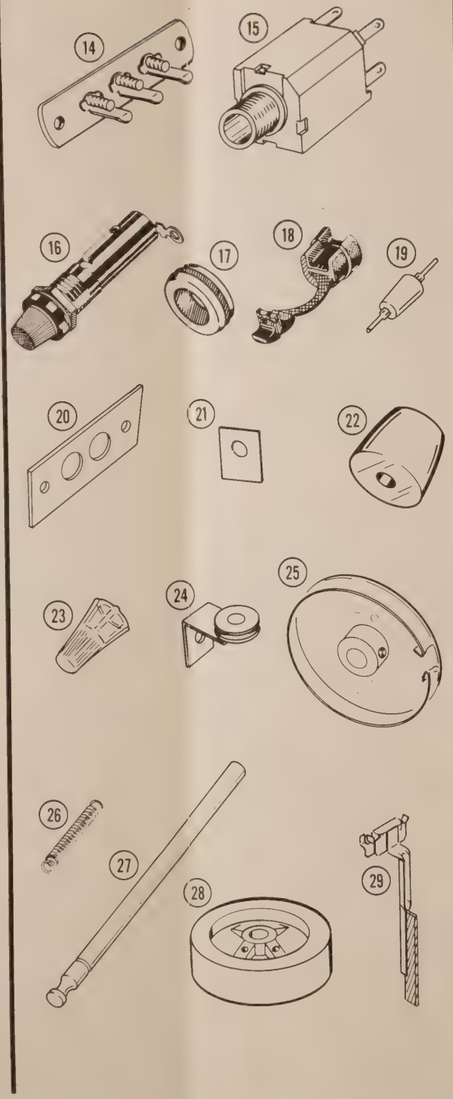
Remove the remaining parts from the shipping carton and check them against the following Parts List. The numbers in parentheses are keyed to the numbers on the Chassis Parts Pictorial (fold-out from Page 33).

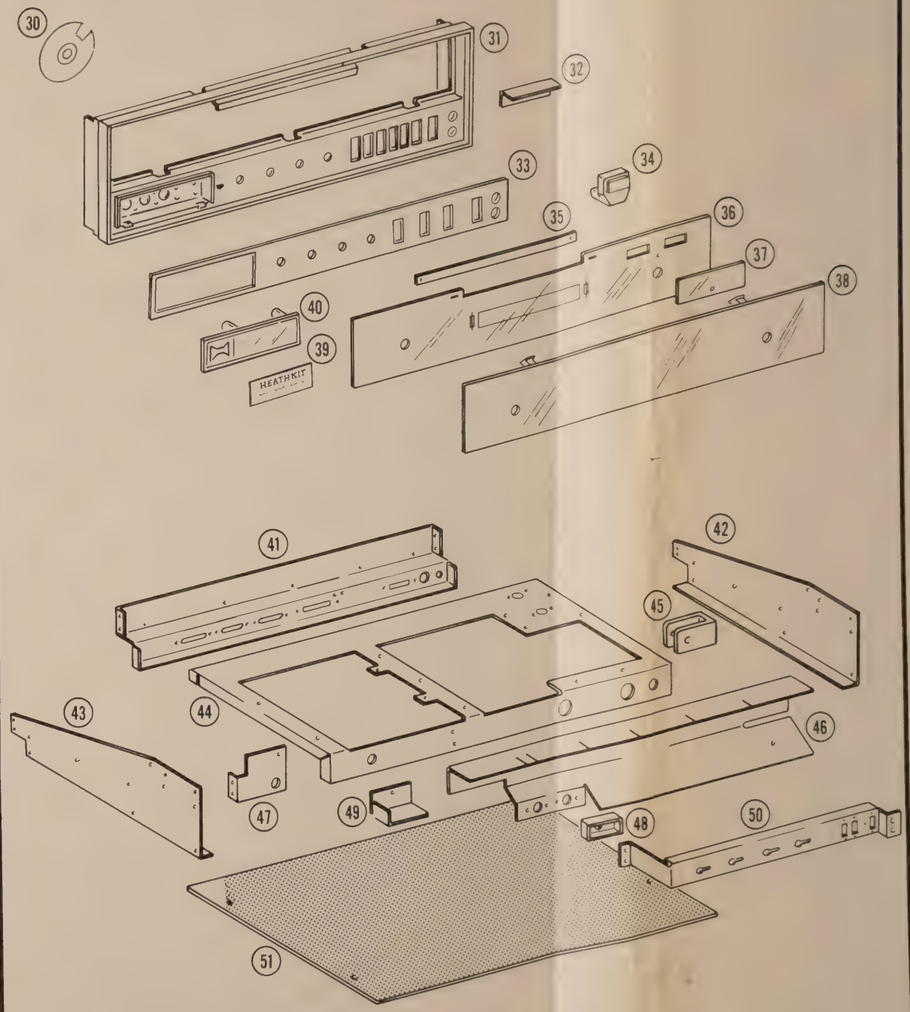
PART No.	PARTS Per Kit	DESCRIPTION
TRANSISTOR - LAMPS - FUSE		
(1) 417-175	1	TA2911 transistor
(2) 412-14	7	#44 pilot lamp
412-58	1	#1813 pilot lamp STEREO
(3) 421-20	1	1/2 ampere slow-blow fuse
SWITCHES - CONTROLS		
(4) 60-31	2	DPDT rocker switch (white)
60-32	1	DPDT rocker switch (black)
(5) 63-480	1	3-position rotary switch
(6) 10-168	1	500 Ω control (with leads)
(7) 10-235	1	1000 Ω control
(8) 12-86	1	250 kΩ tandem control
12-87	1	250 kΩ tandem control
(9) 19-120	1	10 kΩ control with DPDT switch
SOCKETS		
(10) 434-85	7	Pilot lamp socket (with lead)
(11) 434-171	1	Pilot lamp socket (without lead)
(12) 434-174	3	Dual phono socket
(13) 434-147	1	AC socket

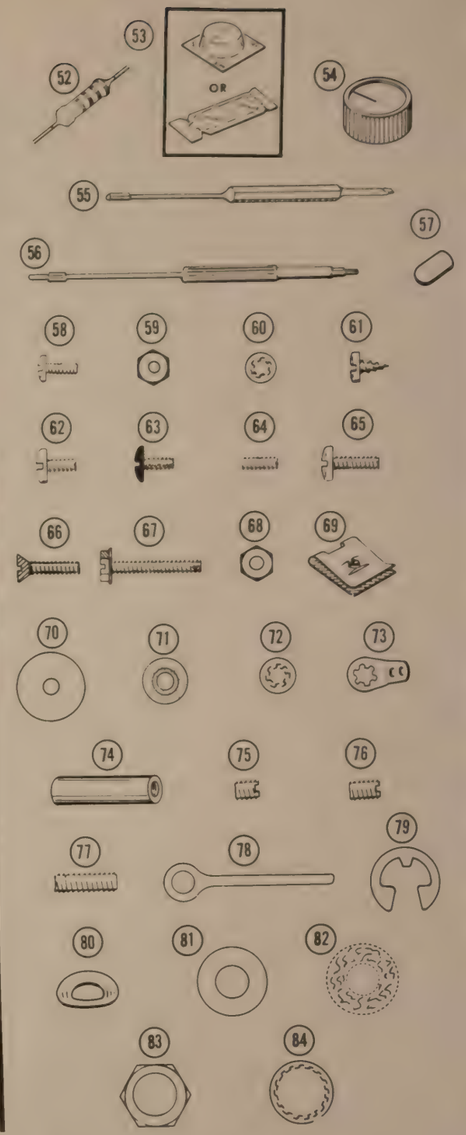
PART No.	PARTS Per Kit	DESCRIPTION
TERMINAL STRIP - PHONE JACKS - FUSEHOLDER		
(14) 431-8	1	Screw-type terminal strip
(15) 436-27	2	Phone jack
(16) 423-2	1	Fuseholder
INSULATORS - FEET		
(17) 73-3	2	1/2" rubber grommet
73-2	1	3/4" rubber grommet
(18) 75-24	1	Line cord strain relief
75-68	1	Insulator sheet (adhesive backed)
(19) 75-87	5	Feedthrough insulator
(20) 75-96	3	Phono socket insulator
(21) 75-704	1	Transistor insulator (packaged between two pieces of cardboard)
(22) 261-17	4	Plastic foot
(23) 432-67	1	Wire nut
DIAL PARTS		
(24) 100-622	4	Dial pulley
(25) 100-642	1	Dial drum
100-643	1	Dial cord
(26) 258-1	1	Dial spring
(27) 453-159	1	Dial shaft
(28) 454-2	1	Flywheel
(29) 463-44	1	Dial pointer

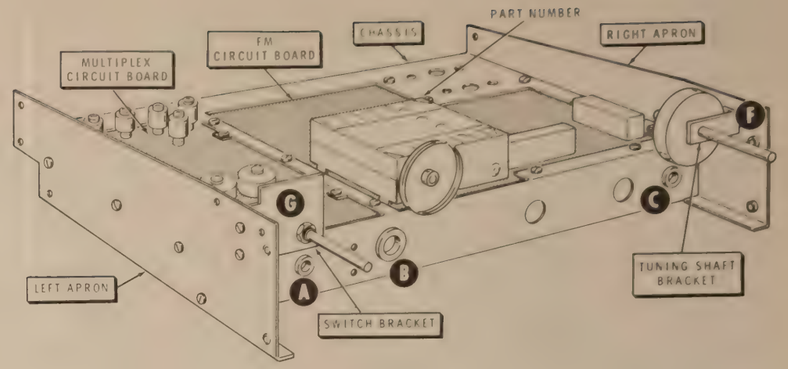
CHASSIS PARTS PICTORIAL



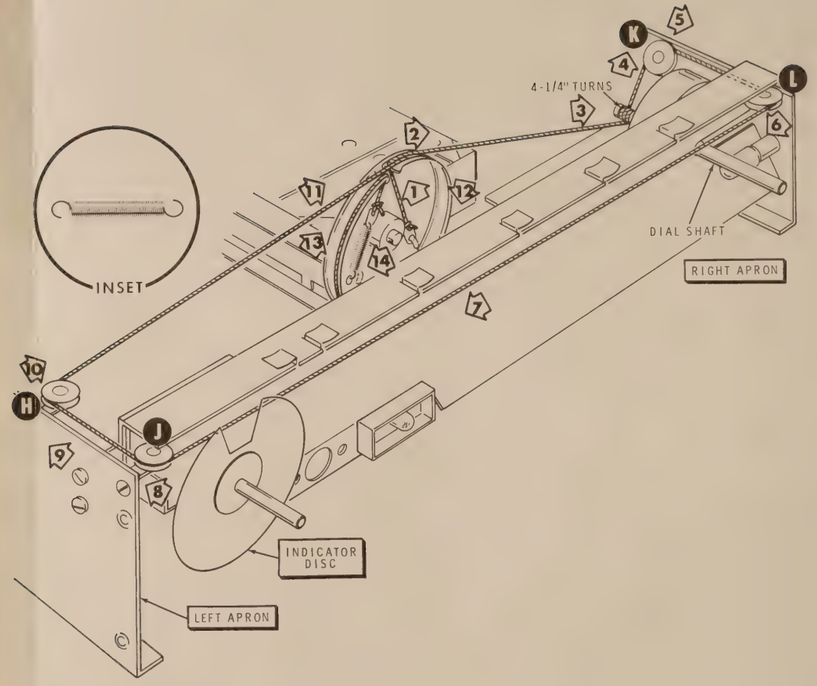




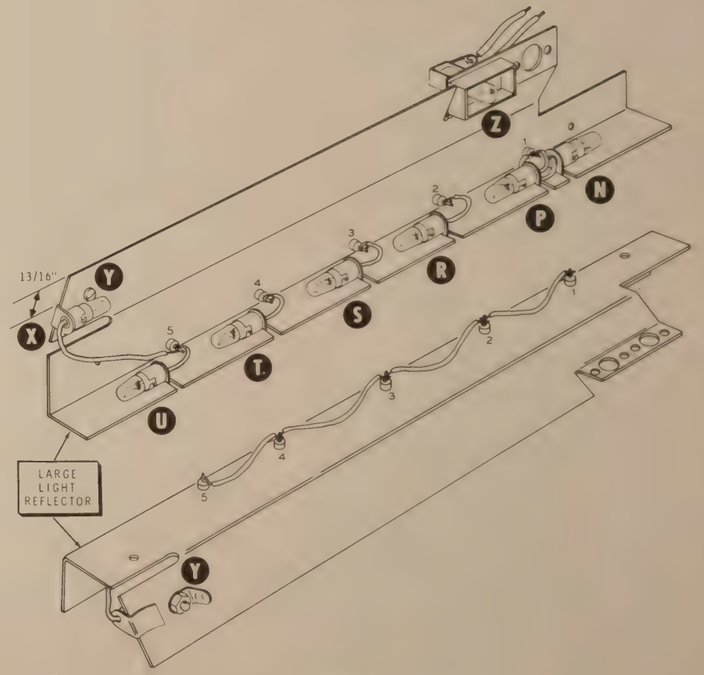




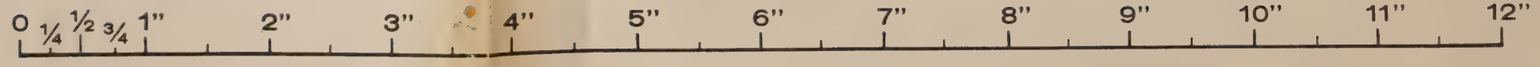
PICTORIAL 3-1

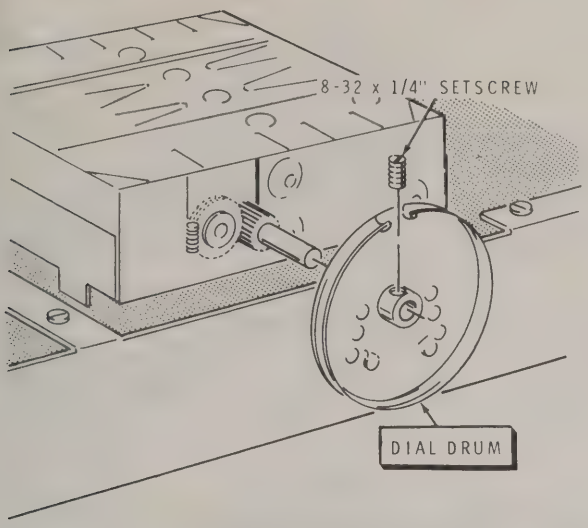


PICTORIAL 3-3



PICTORIAL 3-2





Detail 3-1C

( ) Refer to Detail 3-1C, and install the dial drum on the FM tuning shaft. Push the dial drum tight against the gear on the FM tuning unit and position the opening in the dial drum straight-up. Now tighten the setscrew.

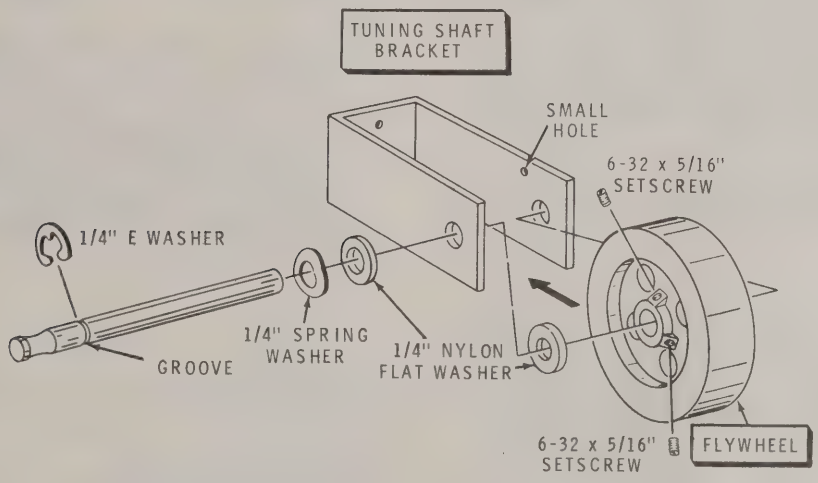
Refer to Detail 3-1D for the following steps.

( ) Start two 6-32 x 5/16" setscrews in the tapped holes of the flywheel.

( ) Install the 1/4" E washer in the indicated narrow groove of the tuning shaft. Make sure it snaps into place in the groove of the shaft.

( ) Place a 1/4" spring washer and a 1/4" nylon flat washer on the dial shaft as shown.

( ) Position the tuning shaft bracket with the small hole as shown, and the flywheel with its setscrew side as shown. Then assemble these parts with a 1/4" nylon flat washer between the tuning shaft bracket and the flywheel as shown.



Detail 3-1D

Refer to Detail 3-1E for the following steps.

( ) Push on the grooved end of the dial shaft until the spring washer is against the other nylon washer. Then push the flywheel against its nylon washer and tighten the setscrews in the flywheel. Be sure the flywheel turns freely. If it does not, loosen the setscrews and allow the shaft to slide out of the flywheel slightly. Retighten the setscrews.

( ) Apply a drop of oil to the dial shaft where it fits through the dial shaft bracket. Be very careful not to get oil in the wide groove of the dial shaft, as this would cause the dial cord to slip later.

NOTE: Do not use any of the black screws unless they are specifically called for in a step.

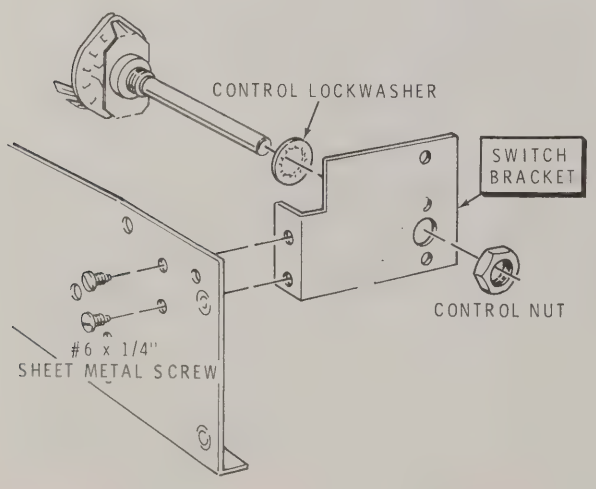
( ) Mount the tuning shaft bracket at F on the right apron. Use 6-32 x 1/4" screws.

Refer to Pictorial 3-1 for the following steps.

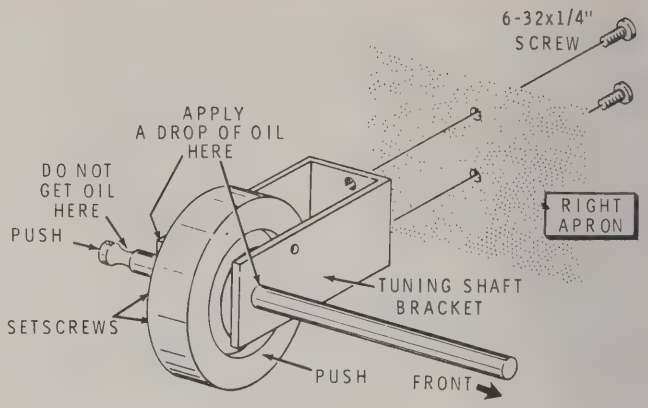
( ) Mount the 3-position rotary switch (#63-480) on the switch bracket with a control lockwasher and a control nut. Be sure to position the switch as shown in Detail 3-1F.

( ) Refer to Detail 3-1F, and mount the switch bracket at G on the left apron with #6 x 1/4" sheet metal screws.

Set the chassis aside temporarily.



Detail 3-1F



Detail 3-1E

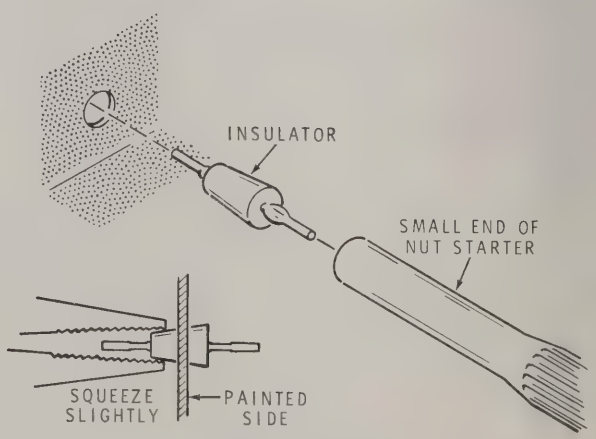
LIGHT REFLECTOR ASSEMBLY

Refer to Pictorial 3-2 (fold-out from Page 34) for the following steps.

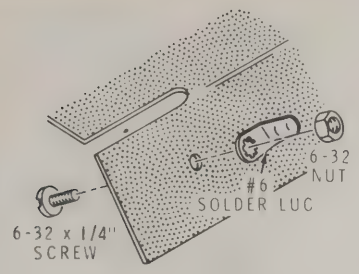
NOTE: Be careful to avoid scratching the white surface of the light reflector when performing the following steps.

( ) Locate the large light reflector and position it as shown.

( ) Refer to Detail 3-2A and install feedthrough insulators in holes 1 through 5 in the large light reflector. Use the small end of the nut starter to push the insulators firmly into the holes from the painted side. Then squeeze the tapered end of the insulator slightly with pliers. This will hold the insulator in place.



Detail 3-2A

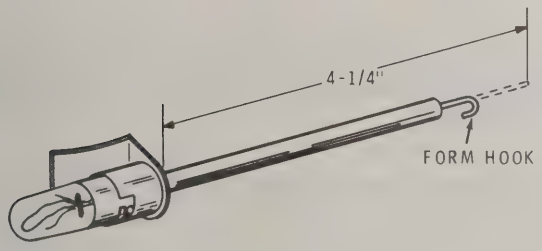


Detail 3-2B

( ) Refer to Detail 3-2B and mount a #6 solder lug at Y on the large light reflector. Use a 6-32 x 1/4" screw and a 6-32 nut.

( ) Refer to Detail 3-2C and prepare the lead end of one of the pilot lamp sockets with leads. Cut the lead to a length of 4-1/4". Remove 1/4" of insulation and melt a small amount of solder on the exposed lead end to hold the small wire strands together. Then form this lead end into a small hook as shown.

( ) In a like manner, prepare the lead ends of the remaining six pilot lamp sockets with leads. Cut these socket leads to 1-1/2" before preparing the lead ends.



Detail 3-2C

( ) Install the #44 pilot lamps in each of the seven prepared pilot lamp sockets.

( ) Install the socket with the longest lead at X on the light reflector.

( ) Install one of the sockets with a short lead at U on the light reflector.

( ) Connect the leads from sockets U and X to feedthrough insulator 5 (S-2). Position the leads as shown.

( ) Install the remaining pilot lamp sockets with leads at locations N, P, R, S, and T.

( ) Connect the lead from socket T to feedthrough insulator 4 (S-1).

( ) Connect the lead from socket S to feedthrough insulator 3 (S-1).

( ) Connect the lead from socket R to feedthrough insulator 2 (S-1).

( ) Connect the leads from sockets N and P to feedthrough insulator 1 (S-2).

NOTE: When wiring this kit, you will be instructed to prepare the lengths of hookup wire ahead of time, as in the following step. To prepare a wire, cut it to the indicated length and remove 1/4" of insulation from each end. The wires are listed in the order in which they will be used.

( ) Prepare the following lengths of red hookup wire:

2-1/2"
3-1/8"
3-1/8"
2-7/8"
3"
4"

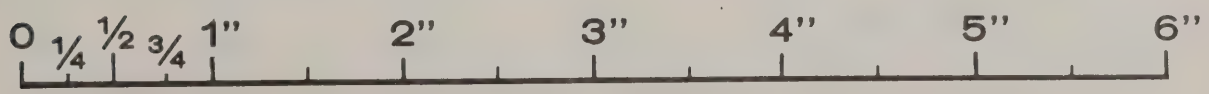
Connect the following wires to the feedthrough insulators on the large light reflector.

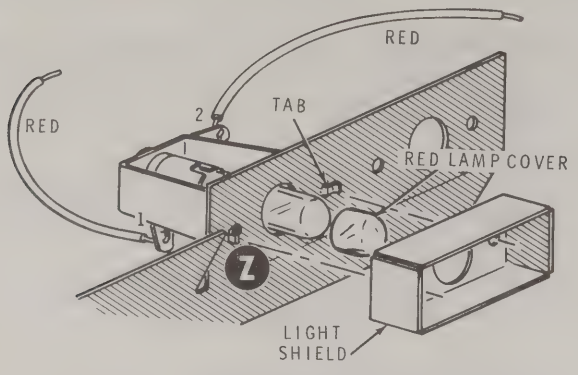
( ) 2-1/2" red wire from 5 (NS) to 4 (NS).

( ) 3-1/8" red wire from 4 (S-2) to 3 (NS).

( ) 3-1/8" red wire from 3 (S-2) to 2 (NS).

( ) 2-7/8" red wire from 2 (S-2) to 1 (S-1).





Detail 3-2D

( ) Push a red lamp cover over a #1813 pilot lamp.

( ) Install the pilot lamp into the pilot lamp socket.

( ) Refer to Detail 3-2D, and mount the remaining pilot lamp socket (without lead) and the light shield at Z on the large light reflector. To install this socket, squeeze the two sides together and fit its tabs through the holes in the large light reflector and light shield. Position the socket as shown.

( ) Connect one end of a 3" red wire to lug 1 of pilot lamp socket Z (S-1).

( ) Connect one end of a 4" red wire to lug 2 of pilot lamp socket Z (S-1).

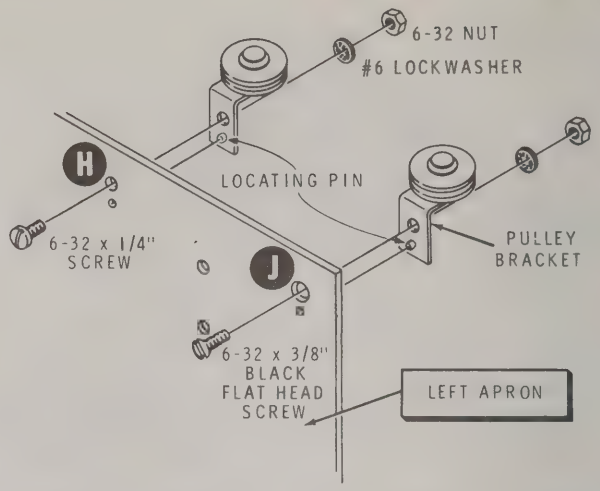
The free ends of these wires will be connected later.

DIAL STRINGING

Refer to Pictorial 3-3 (fold-out from Page 34) for the following steps.

( ) Refer to Detail 3-3A and install dial pulleys at H on the left apron and K on the right apron. Use 6-32 x 1/4" hardware. Align the locating pins of the pulley brackets with the locating holes in the aprons.

( ) In a like manner, install dial pulleys at J on the left apron and L on the right apron. Use 6-32 x 3/8" black flat head screws, #6 lockwashers, and 6-32 nuts.



Detail 3-3A

( ) Now bend the dial pulley at K down so the groove in the pulley is in line with the dial shaft.

( ) Refer to Detail 3-3B, and mount the large light reflector to the tuning shaft bracket with a 6-32 x 1/4" screw and a #6 lockwasher.

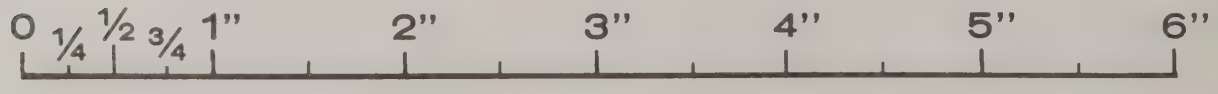
NOTE: In the following step, it will be necessary to remove the pilot lamp from socket N to mount the reflector.

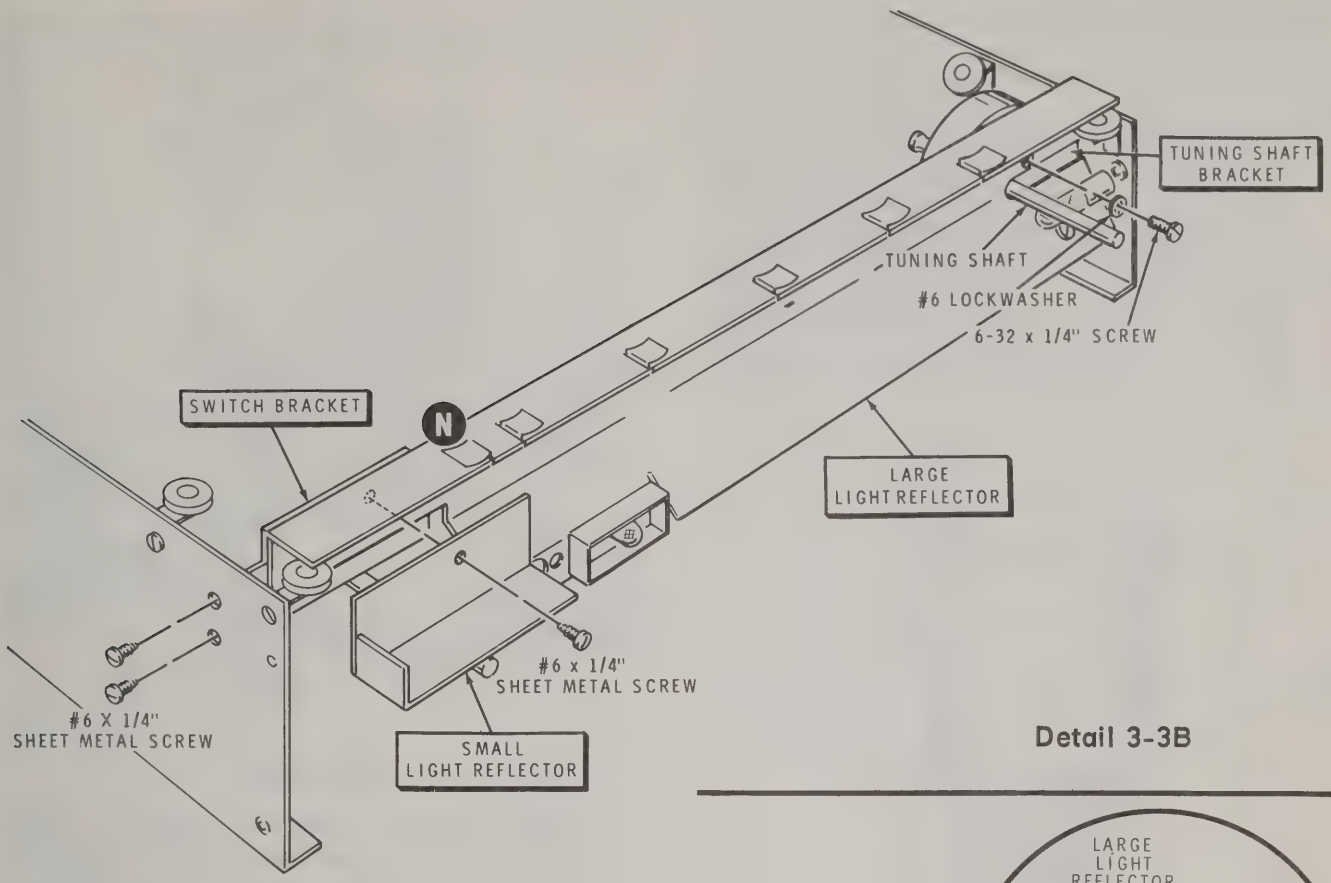
( ) Mount the small light reflector and large light reflector to the switch bracket with a #6 x 1/4" sheet metal screw as shown in Detail 3-3B.

( ) Replace the pilot lamp in socket N.

( ) Turn the shaft of the rotary switch to its center position.

( ) Start an 8-32 x 1/4" setscrew in the bushing of the indicator disc (#100-621) as shown in Detail 3-3C.





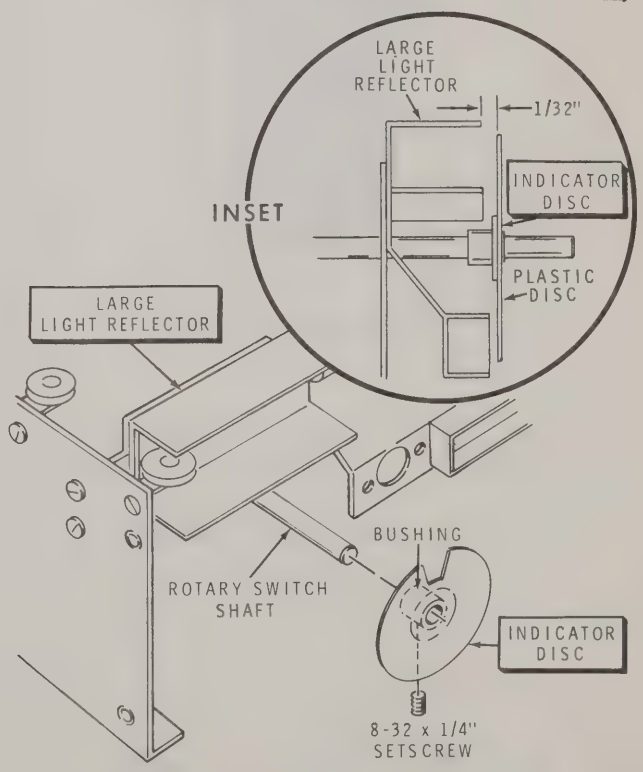
Detail 3-3B

( ) Install the indicator disc on the shaft of the rotary switch so the plastic disc is 1/32" in front of the large light reflector. See the inset drawing on Detail 3-3C. With the cut-out of the disc straight up, tighten the set-screw.

( ) Locate the dial spring and bend open the hooks at each end of the spring slightly as shown in the inset drawing on Pictorial 3-3.

( ) Be sure the dial drum is in its fully clockwise position.

( ) Install the dial cord (#100-643) by following the numbered arrows on Pictorial 3-3, starting at number 1, and complete the dial stringing. At arrow number 14, connect the dial spring between the end of the dial cord and the indicated hole in the dial drum.

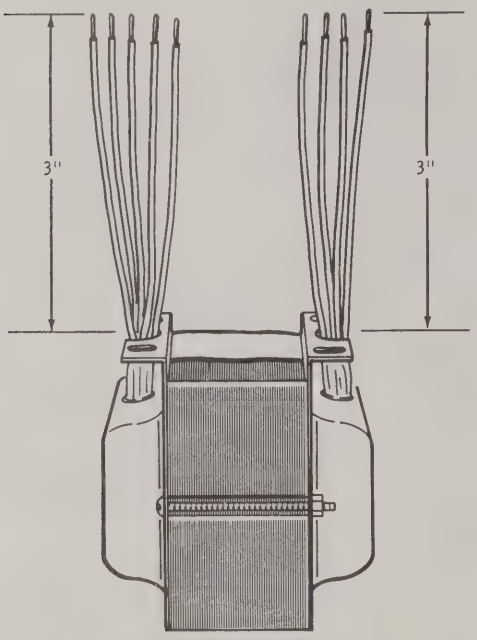


Detail 3-3C

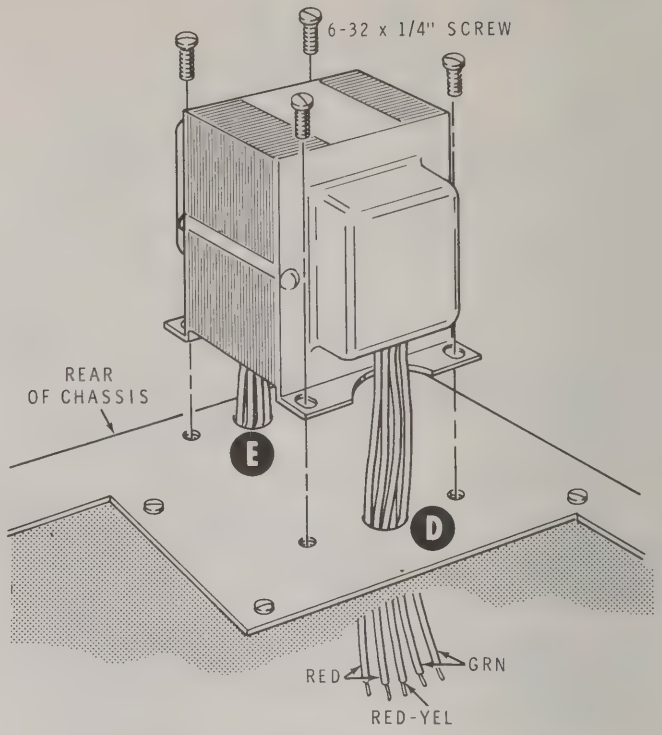
TRANSFORMER WIRING

Refer to Pictorial 3-4 for the following steps.

( ) Refer to Detail 3-4A and prepare the power transformer leads. To prepare the leads, cut them to the dimensions shown. Measure the leads as shown from the mounting foot of the Transformer. Then remove 1/4" of insulation from each lead and melt a small amount of solder on the exposed end to hold the wire strands together. Some leads may already have solder on them.

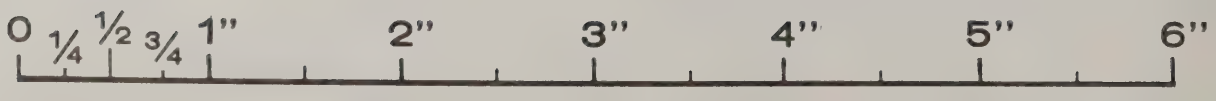


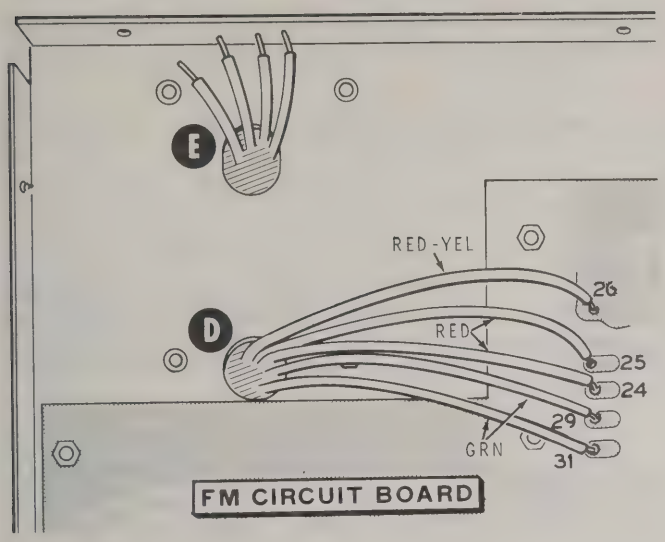
Detail 3-4A



Detail 3-4B

( ) Refer to Detail 3-4B and mount the power transformer on the chassis. Use 6-32 x 1/4" screws. Be sure to pass the proper wires through holes D and E of the chassis. Push the transformer all the way toward the front of the chassis before tightening the hardware.





PICTORIAL 3-4

NOTE: When connecting wires to the foil side of the circuit board, as in the following steps, do not push the insulation down tight against the foil. Leave the insulation approximately 1/8" away from the foil to be sure of making a good solder connection to the foil and wire being connected.

Connect the power transformer wires extending from hole D in the chassis to the FM circuit board as follows:

( ) Red-yellow to hole 26 (S-1).

( ) Either red to hole 25 (S-1).

( ) Other red to hole 24 (S-1).

( ) Either green to hole 29 (S-1).

( ) Other green to hole 31 (S-1).

The remaining transformer leads will be connected later.

HARNESS WIRING

Refer to Pictorial 3-5 for the following steps.

( ) Unfold the wiring harness and position it into the chassis as shown. Locate BO #1 (breakout 1). Pass this end of the harness through grommet B. Position this portion of the harness so that breakouts 4, 5, 6, and 7 are along the front of the chassis. Then pass breakouts 1, 2, and 3 through grommet C.

NOTE: Some of the harness wires may seem too long, however, they should not be shortened. Any excess wire should be positioned under the main portion of the harness for neatness. The wires at some of the breakouts that are not connected at this time will be connected later.

Connect the wires from BO #1 to the FM circuit board as follows:

( ) Brown to hole 30 (S-1).

( ) White-black to hole 32 (S-1).

( ) Short yellow to hole 5 (S-1).

( ) Green to either hole at 27 (S-1).

( ) Red to other hole at 27 (S-1).

( ) Long yellow to hole 12 (S-1).

Connect the wires from BO #1 to the switch on the FM circuit board as follows:

( ) White-red to lug 1 (S-1).

( ) White to lug 2 (S-1).

( ) Connect the yellow wire from BO #2 to either hole at 4 (S-1).

Connect the wires from BO #3 to the FM circuit board as follows:

( ) Red to other hole at 4 (S-1).

( ) Blue to hole 8 (S-1).

NOTE: When a shielded cable is not color coded (with tape, color stripe, or other color marking) it will be referred to as "black shielded cable" in a step.

( ) Black shielded cable inner lead to hole 3 (S-1) and its shield lead to the adjacent hole S (S-1).

( ) White-yellow to hole 28 (S-1).

Connect the wires from BO #12 to the FM circuit board as follows:

( ) Blue to hole 11 (S-1).

( ) Orange to hole 14 (S-1).

( ) Short yellow to hole 13 (S-1).

( ) White shielded cable inner lead to hole 33 (S-1) and its shield lead to the adjacent hole S (S-1).

( ) Black shielded cable inner lead to hole 22 (S-1) and its shield lead to the adjacent hole S (S-1).

( ) Red shielded cable inner lead to hole 21 (S-1) and its shield lead to the adjacent hole S (S-1).

Connect the wires from BO #12 to the multiplex circuit board as follows:

( ) Green to hole 15 (S-1).

( ) Violet to hole 16 (S-1).

( ) Long yellow to hole 20 (S-1).

( ) White-blue to hole 9 (S-1).

( ) White-yellow to hole 22 (S-1).

Connect the wires from BO #13 to the FM circuit board as follows:

( ) Orange shielded cable inner lead to hole 36 (S-1) and its shield lead to the adjacent hole S (S-1).

( ) White-orange to hole 19 (S-1).

( ) White-yellow to hole 17 (S-1).

Connect the wires from BO #13 to the multiplex circuit board as follows:

( ) Green to hole 8 (S-1).

( ) White-brown to hole 14 (S-1).

( ) Black to hole F (S-1).

( ) Brown to hole G (S-1).

( ) Position the wires from BO #9 through grommet A for connection later.

Connect the wires from BO #8 to the multiplex circuit board as follows:

( ) White-red to hole 19 (S-1).

( ) White-yellow to hole 12 (S-1).

( ) Yellow to hole 11 (S-1).

( ) Brown to hole 13 (S-1).

( ) Orange to hole 2 (S-1).

( ) Green to hole 1 (S-1).

Connect the wires from BO #10 to the multiplex circuit board as follows:

( ) Black shielded cable inner lead to hole 10 (S-1) and its shield lead to the adjacent hole S (S-1).

( ) Red to hole 3 (S-1).

( ) White-red to hole 4 (S-1).

( ) Gray to hole 6 (S-1).

Connect the wires from BO #11 to the multiplex circuit board as follows:

( ) Green shielded cable inner lead to hole 17 (S-1). There is no shield lead at this end of the cable.

( ) Brown to hole G (S-1).

( ) Black to hole F (S-1).

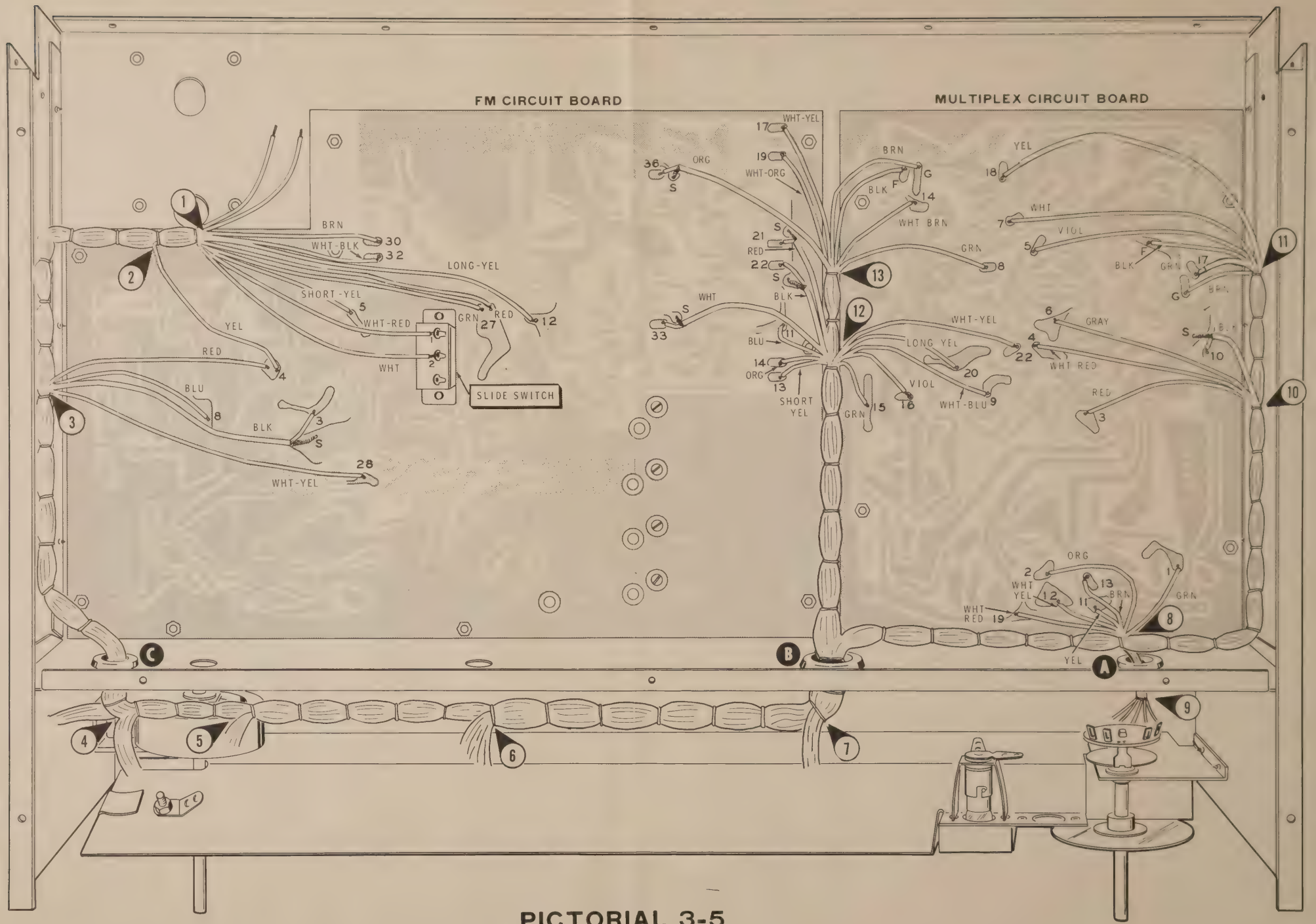
( ) Violet to hole 5 (S-1).

( ) White to hole 7 (S-1).

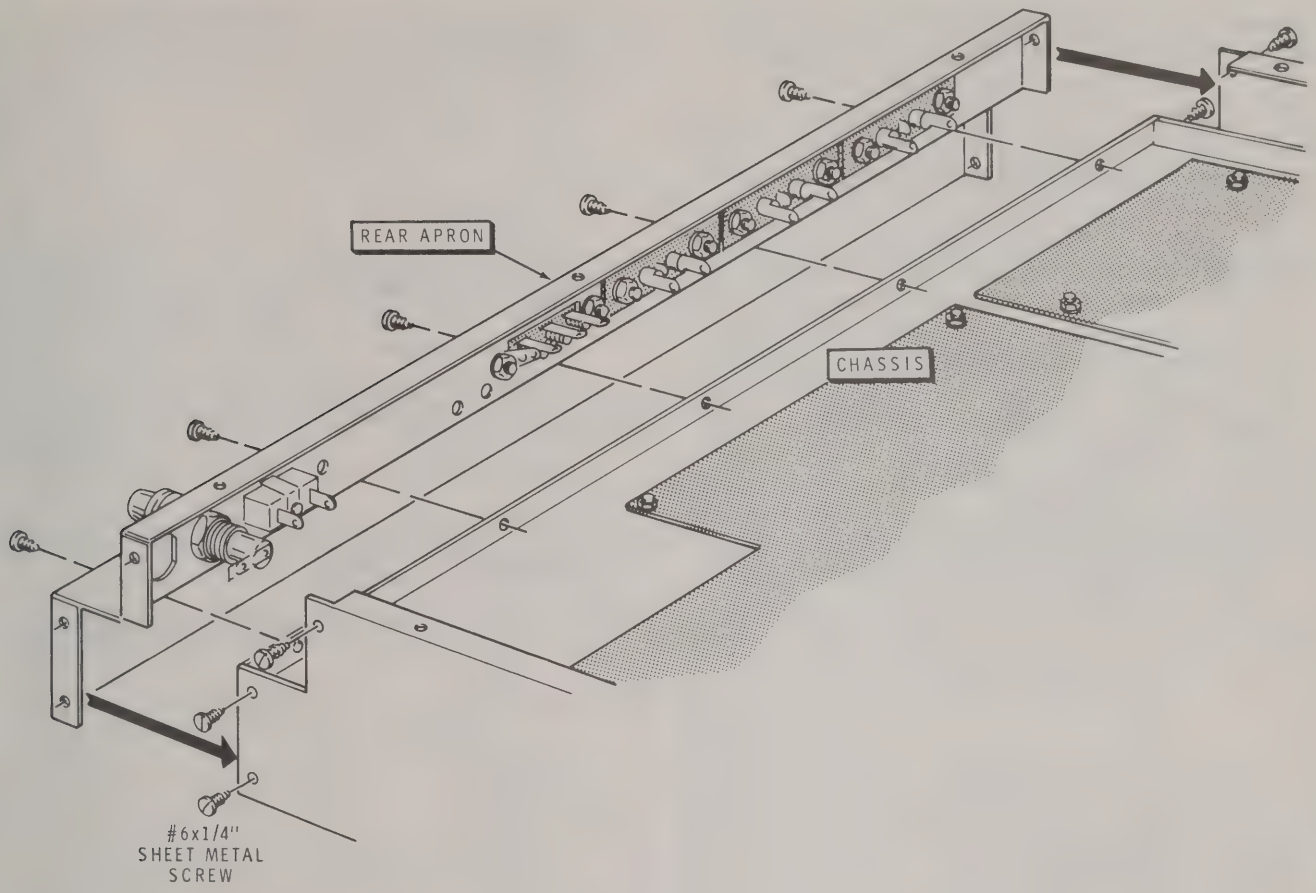
( ) Yellow shielded cable inner lead to hole 18 (S-1). There is no shield lead at this end of the cable.

This completes the harness wiring to the circuit boards. Check to see that all wires have been installed in the proper holes.

( ) Set the chassis aside temporarily.



PICTORIAL 3-5



Detail 3-6B

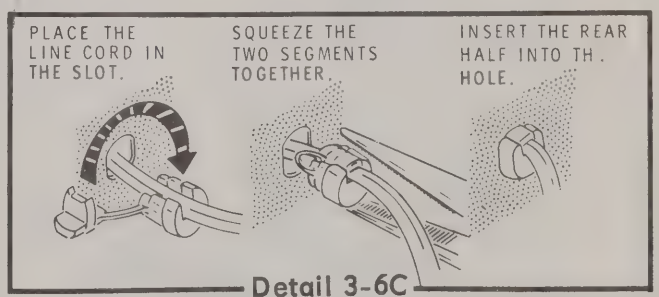
Refer to Pictorial 3-6 for the following steps.

(✓) Refer to Detail 3-6B and mount the rear apron on the chassis with eleven #6 x 1/4" sheet metal screws. Do not pinch any wires between the chassis and rear apron.

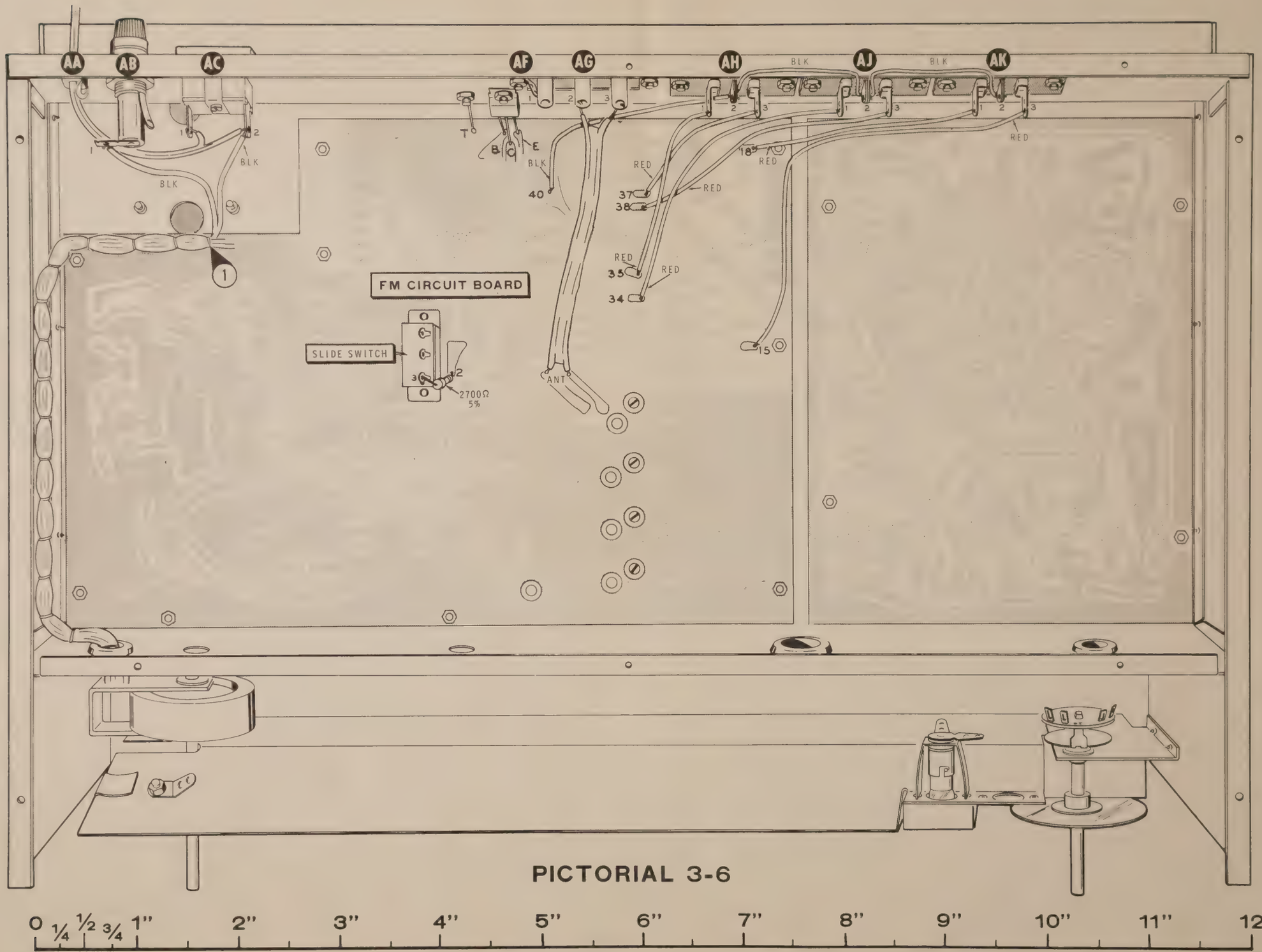
( ) Locate the line cord and melt a small amount of solder on each exposed lead end to hold the small strands together.

( ) Insert the line cord through hole AA. Connect one lead to lug 1 (NS) and the other lead to lug 2 (NS) of socket AC.

( ) Refer to Detail 3-6C and install the line cord strain relief in hole AA.



Detail 3-6C



PICTORIAL 3-6

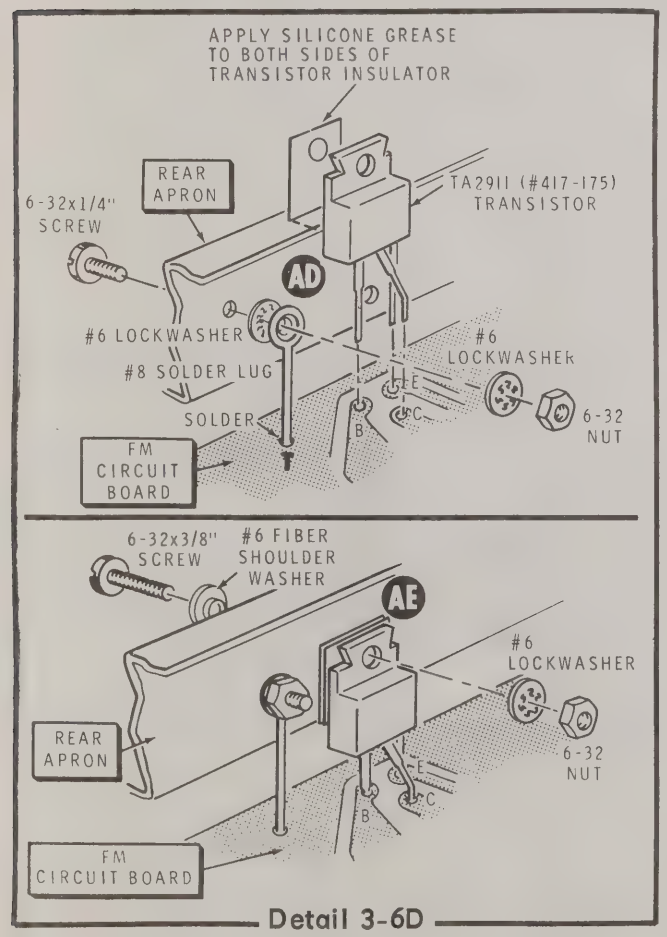
Connect the black wires from BO #1 of the harness as follows:

( ) Either black to lug 1 of fuseholder AB (S-1).

( ) Other black to lug 2 of socket AC (S-2).

( ) Connect a 2700 Ω 5% (red-violet-red) resistor from hole 2 in the FM circuit board (S-1) to lug 3 of the slide switch mounted on the circuit board (S-1). Position the resistor as shown and cut off the excess lead lengths. Be sure the resistor body does not touch the frame of the switch.

( ) Refer to Detail 3-6D and position the small end of a #8 solder lug into hole T of the FM circuit board. Then secure the solder lug to the rear apron at hole AD with 6-32 x 1/4" hardware.



Detail 3-6D

( ) Now solder the solder lug to the foil of the circuit board and cut off the excess that extends from the top side of the circuit board.

( ) Apply a liberal amount of silicone grease to both sides of the transistor insulator as shown in Detail 3-6D. Completely cover both sides of the insulator.

( ) Position the E, B, and C leads of the TA2911 (#417-175) transistor into the corresponding holes of the FM circuit board. Then mount the transistor at hole AE with the transistor insulator, a 6-32 x 3/8" screw, a #6 fiber shoulder washer, a #6 lockwasher, and a 6-32 nut. Be careful not to overtighten the hardware, as this could cause the transistor to short to the chassis.

( ) Now solder the three connections of this transistor to the foil.

( ) Prepare the following lengths of hookup wire.

COLOR	LENGTH
Black	5"
Black	3"
Black	3"
Red	5"
Red	2-3/4"
Red	4-1/2"
Red	3-1/2"
Red	5-1/2"
Red	8"

( ) Connect a 5" black wire from hole 40 in the FM circuit board (S-1) to lug 2 of phono socket AH (NS). NOTE: There are two lugs at location 2. Both lugs should be connected together on sockets AH, AJ, and AK.

( ) Connect a 3" black wire from lug 2 of socket AH (S-2) to lug 2 of socket AJ (NS).

( ) Connect a 3" black wire from lug 2 of socket AJ (S-2) to lug 2 of socket AK (S-1).

CAUTION: When performing the following steps, be careful not to burn any of the wires already connected to the circuit boards.

( ) Connect a 5" red wire from hole 18 on the FM circuit board (S-1) to lug 1 of socket AK (S-1).

( ) Connect a 2-3/4" red wire from hole 37 on the FM circuit board (S-1) to lug 3 of socket AH (S-1).

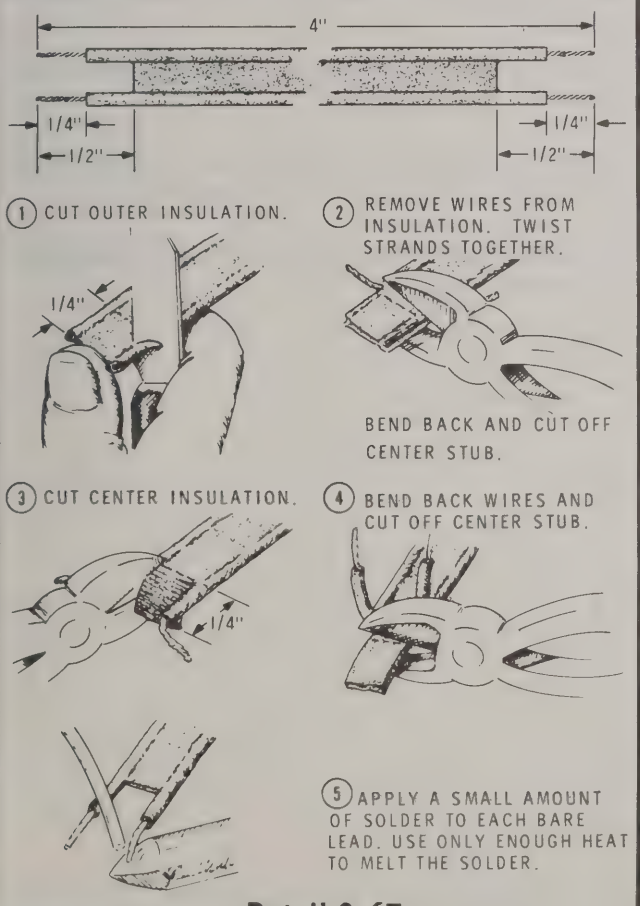
( ) Connect a 4-1/2" red wire from hole 38 of the FM circuit board (S-1) to lug 3 of socket AJ (S-1).

( ) Connect a 3-1/2" red wire from hole 35 of the FM circuit board (S-1) to lug 1 of socket AH (S-1).

( ) Connect a 5-1/2" red wire from hole 34 of the FM circuit board (S-1) to lug 1 of socket AJ (S-1).

( ) Connect an 8" red wire from hole 15 in the FM circuit board (S-1) to lug 3 of socket AK (S-1). NOTE: Position this wire under the harness wires already connected to the circuit board.

( ) Refer to Detail 3-6E, and prepare each end of a 4" length of 300 Ω twin lead.



Detail 3-6E

( ) At one end of the twin lead, connect the leads to the holes lettered ANT on the FM circuit board. Solder both connections.

( ) At the other end of the twin lead, connect one lead to lug 2 (S-1) and the other lead to lug 3 (S-1) of terminal strip AG.

( ) Be sure solder lug AF is bent against lug 1 of terminal strip AG (S-1).

ALTERNATE LINE VOLTAGE WIRING

Two sets of line voltage wiring instructions are given below, one for 120 VAC line voltage and the other for 240 VAC line voltage. In the U.S.A., 120 VAC is most often used, while in other countries 240 VAC is more common. USE ONLY THE INSTRUCTIONS THAT AGREE WITH THE LINE VOLTAGE IN YOUR AREA.

120 VAC Wiring

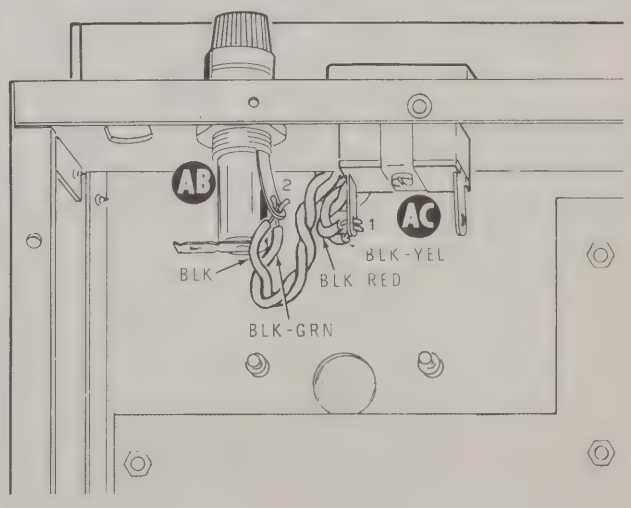
Refer to Detail 3-6F for the following steps.

( ) Connect the black and black-green transformer leads to lug 2 of fuseholder AB (S-2).

( ) Connect the black-red and black-yellow transformer leads to lug 1 of socket AC (S-3).

( ) Install the 1/2 ampere fuse in the fuseholder.

( ) Set the chassis aside temporarily.



Detail 3-6F

240 VAC Wiring

Refer to Detail 3-6G for the following steps.

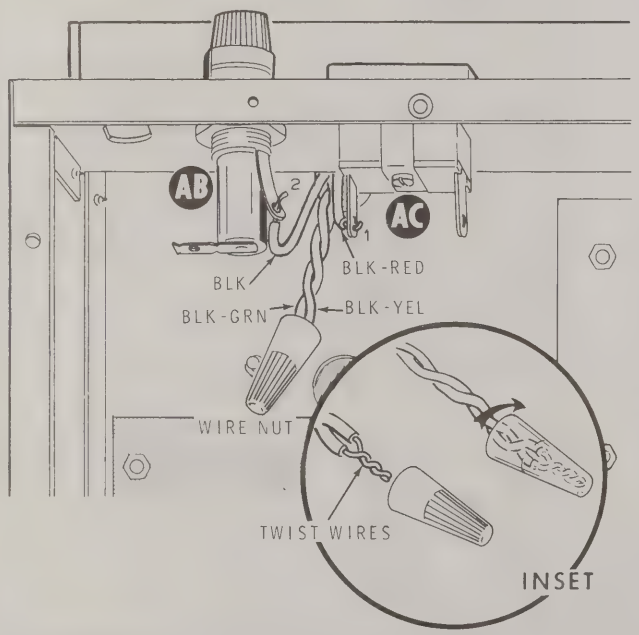
( ) Connect the black transformer lead to lug 2 of fuseholder AB (S-1).

( ) Connect the black-red transformer lead to lug 1 of socket AC (S-2).

( ) Twist together (clockwise) the ends of the black-green and black-yellow transformer leads. Then install the wire nut on the ends of these leads; turn the wire nut in a clockwise direction. See the inset drawing on the Detail.

( ) Install a 1/4 ampere fuse in the fuseholder. This fuse is not furnished with the Tuner.

( ) Set the chassis aside temporarily.



Detail 3-6G

CONTROL BRACKET ASSEMBLY

Refer to Pictorial 3-7 for the following steps.

( ) Locate the control bracket and position it as shown.

( ) Install phone jacks at locations BA and BB on the control bracket with a control lockwasher and a control nut. Be sure to position the beveled corner of each phone jack as shown.

( ) Install the DPDT rocker switch with the black knob at BC with 4-40 x 1/4" screws. Center the switch in its cut-out in the control bracket.

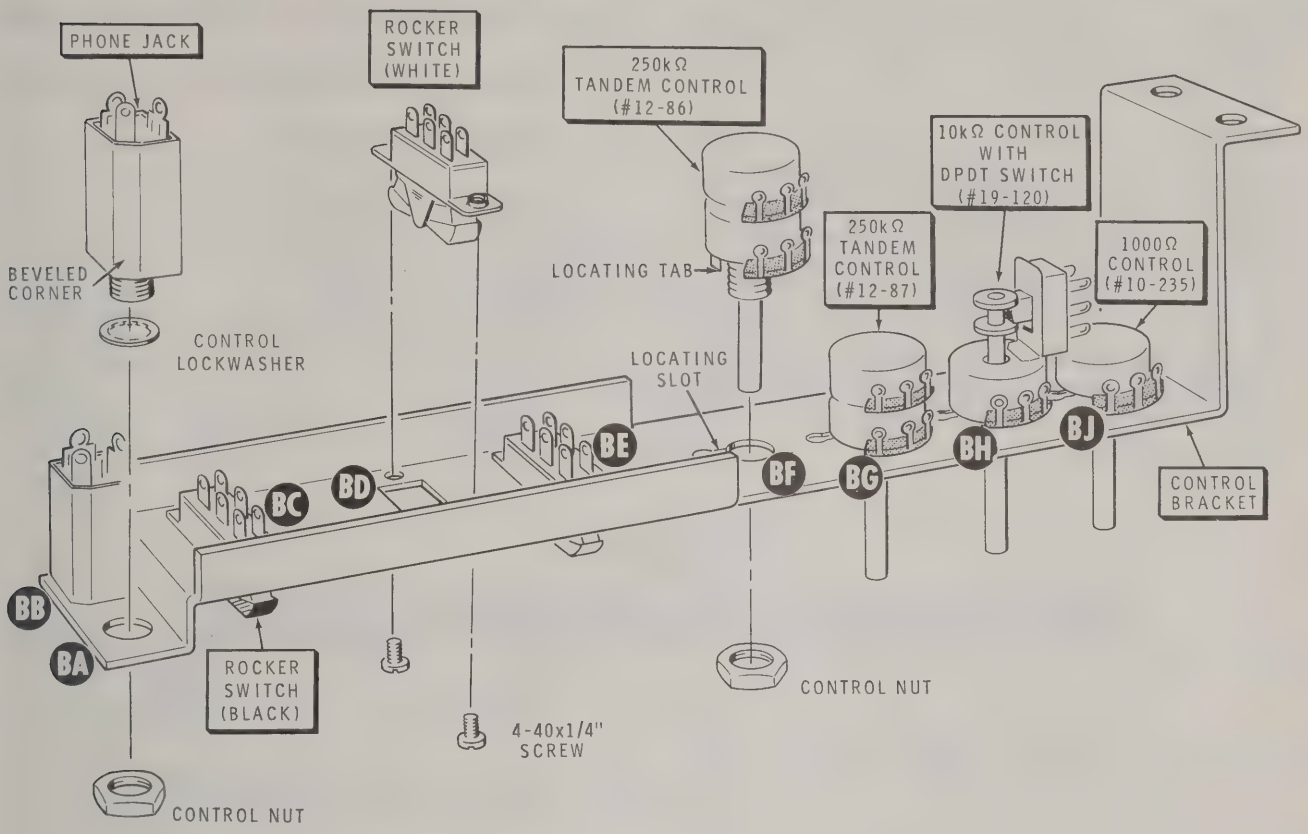
( ) In a like manner, install DPDT rocker switches with white knobs at locations BD and BE with 4-40 x 1/4" screws.

( ) Install 250 kΩ tandem control (#12-86) at BF with a control nut. Position the locating tab of the control in the locating slot of the control bracket.

( ) Install 250 kΩ tandem control (#12-87) at BG with a control nut.

( ) Install a 10 kΩ control with DPDT switch (#19-120) at BH with a control nut.

( ) Install a 1000 Ω control (#10-235) at BJ with a control nut.



PICTORIAL 3-7

Refer to Detail 3-7A for the following steps.

( ) Mount the control bracket on the front panel with 6-32 x 1/4" screws as shown in Part A of the Detail.

( ) Check to see that the phone jacks, rocker switches, and controls are centered in their holes in the front panel. If any of these parts are not centered properly, remove the control bracket and make any necessary adjustments. See Part B of Detail 3-7A.

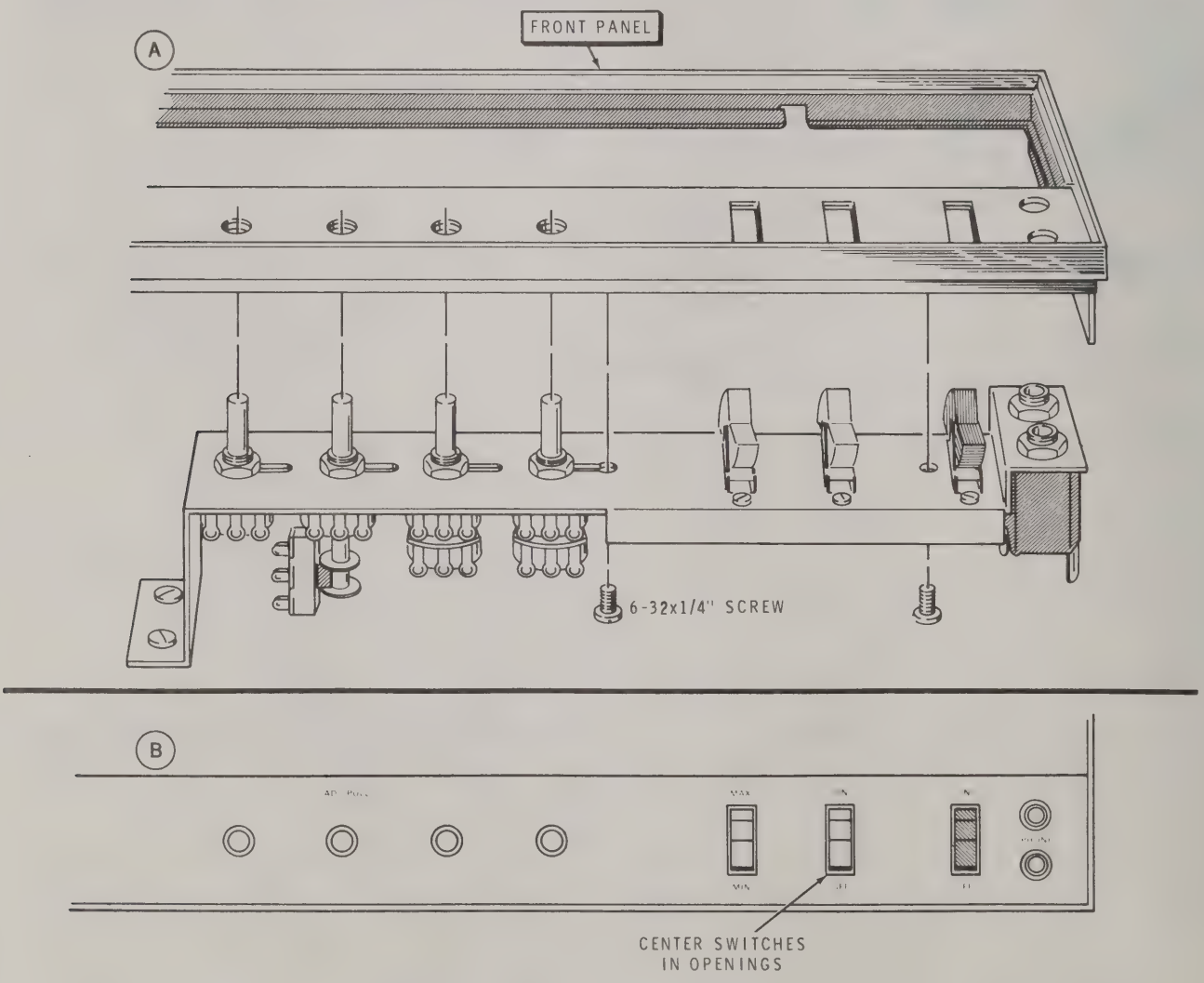
( ) If all the parts are centered properly, remove the control bracket from the front panel. Set the front panel aside until it is called for later.

CONTROL BRACKET PRELIMINARY WIRING

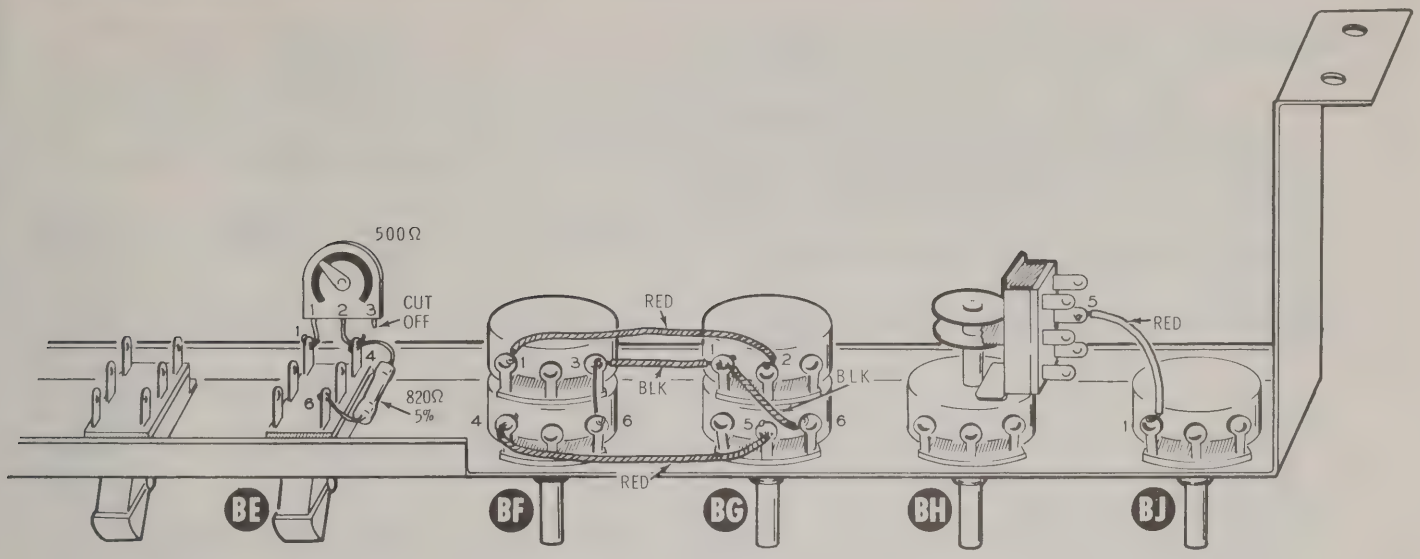
Refer to Pictorial 3-8 for the following steps.

( ) Prepare the following lengths of hookup wire:

COLOR	LENGTH
Black	1-3/4"
Black	1"
Red	2-1/2"
Red	2-1/2"
Red	1-1/2"



Detail 3-7A



PICTORIAL 3-8

( ) Remove an additional 3/4" of insulation from one end of a 1-3/4" black wire. Pass this end of the wire through lug 3 (NS) to lug 6 (NS) of control BF.

( ) Connect the other end of this wire to lug 1 of control BG (NS).

( ) Connect a 1" black wire between lugs 1 (NS) and 6 (NS) of control BG.

( ) Connect a 2-1/2" red wire from lug 1 of control BF (S-1) to lug 2 of control BG (S-1).

( ) Connect a 2-1/2" red wire from lug 4 of control BF (S-1) to lug 5 of control BG (S-1).

( ) Connect a 1-1/2" red wire from lug 5 of the switch on control BH (NS) to lug 1 of control BJ (S-1). Be sure to position this wire as shown.

( ) Locate the 500 Ω control (#10-168) and cut leads 1 and 2 to 1/4".

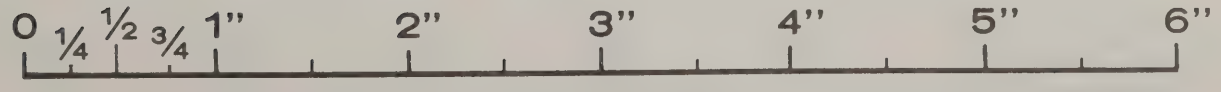
( ) Cut lead 3 close to the body of the control as shown.

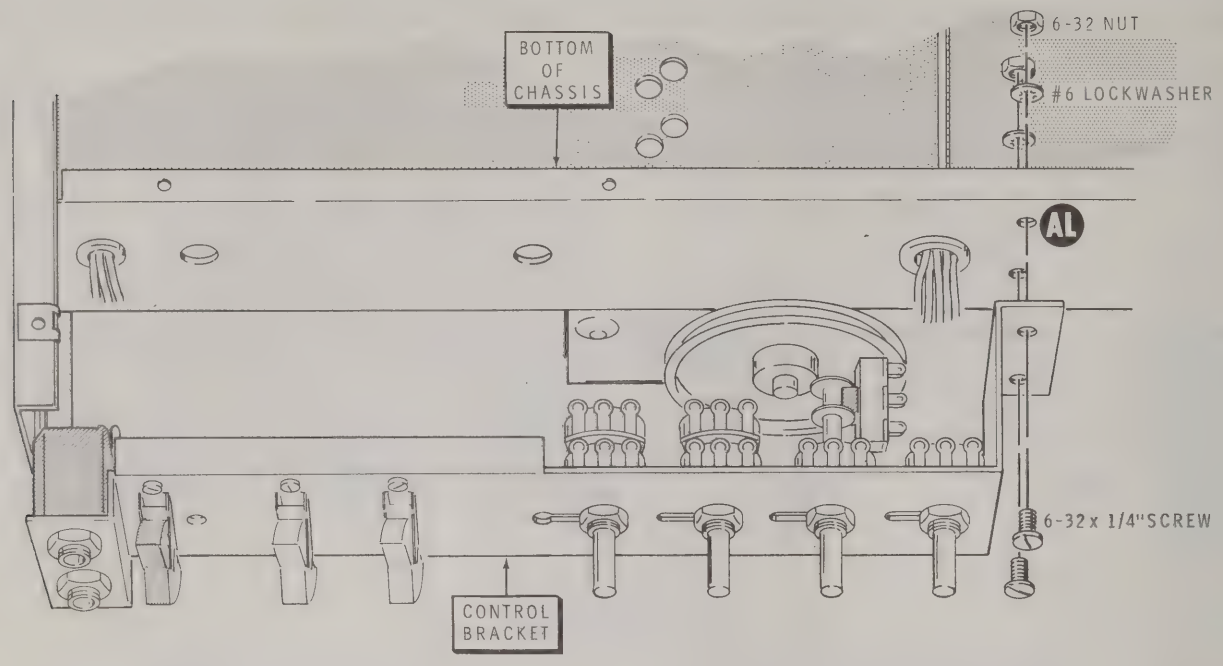
CAUTION: When wiring this control in the following step, be very careful not to break the control as it is quite fragile. Do not overheat the leads during soldering.

( ) Connect lead 1 of this control to lug 1 (NS) and lead 2 to lug 4 (NS) of switch BE. Position the body of the control as shown.

( ) Cut both leads of an 820 Ω 5% (gray-red-brown) resistor to 3/8".

( ) Connect this resistor between lugs 4 (S-2) and 6 (NS) of switch BE. Be sure the body of the resistor does not touch the switch.





Detail 3-8A

( ) Refer to Detail 3-8A, and mount the control bracket on the chassis with 6-32 x 1/4" hardware at AL.

FINAL HARNESS WIRING

Refer to Pictorial 3-9 (fold-out from Page 53) for the following steps.

( ) Connect the free end of the red wire from lug 1 of pilot lamp socket Z to lug 1 of switch G (NS).

( ) Connect the free end of the red wire from lug 2 of pilot lamp socket Z to lug 4 of switch G (NS).

Connect the wires from BO #9 to switch G as follows:

( ) Yellow to lug 4 (S-2).

( ) Green to lug 3 (S-1).

( ) White-blue to lug 2 (S-1).

( ) Blue and white-red to lug 1 (S-3).

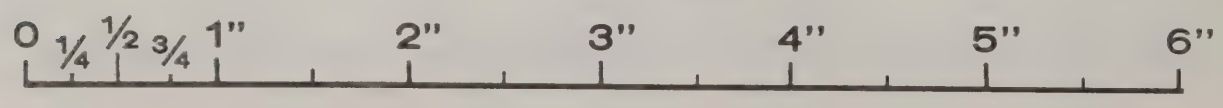
NOTE: When wiring to the four controls in the following steps, be sure to position the cables and wires exactly as shown. This will allow a better fit of the bottom plate.

Connect the wires from BO #7 to the switch on control BH as follows:

NOTE: You may wish to loosen and rotate control BH slightly to make it easier to perform the following five steps. If you do rotate the control, be sure to reposition it and tighten the nut after these steps have been completed.

( ) Brown to lug 4 (S-1).

( ) White-orange to lug 5 (S-2).



( ) White-brown to lug 6 (S-1).

( ) Yellow to lug 1 (S-1).

( ) White-yellow to lug 2 (S-1).

Connect the wires from BO #7 to control BH as follows:

( ) Green to lug 3 (S-1).

( ) Orange to lug 2 (S-1).

Connect the wires from BO #7 to control BJ as follows:

( ) Both gray to lug 3 (S-2).

( ) Violet to lug 2 (S-1).

Connect the wires from BO #6 to control BG as follows:

( ) Yellow shielded cable inner lead to lug 4 (NS) and its shield lead to lug 1 (NS).

( ) White shielded cable inner lead to lug 4 (S-2) and its shield lead to lug 1 (S-4).

( ) Green shielded cable inner lead to lug 3 (NS) and its shield lead to lug 6 (NS).

( ) Orange shielded cable inner lead to lug 3 (S-2) and its shield lead to 6 (S-3).

Connect the wires from BO #6 to control BF as follows:

NOTE: Where a wire passes through a connection and then goes to another point, as in the following step, it will count as two wires in the soldering instructions (S-2), one entering and one leaving the connection.

( ) Black shielded cable inner lead to lug 2 (S-1) and its shield lead to lug 3 (S-3).

( ) Red shielded cable inner lead to lug 5 (S-1) and its shield lead to lug 6 (S-2).

Connect the wires from BO #5 to switch BE as follows:

( ) Gray to lug 1 (S-2).

( ) White to lug 5 (S-1).

( ) Red and white-orange to lug 6 (S-3).

Connect the wires from BO #5 to switch BD as follows:

( ) Violet to lug 5 (S-1).

( ) Green to lug 6 (S-1).

The brown wire will be connected later.

( ) Pass the blue, green, white, and long yellow wires from BO #4 through the slot in the large light reflector as shown. These wires will be connected later.

Connect the wires from BO #4 to phone jack BB as follows:

( ) Orange to lug 1 (S-1).

( ) White-orange to lug 2 (S-1).

Connect the wires from BO #4 to phone jack BA as follows:

( ) Short-yellow to lug 1 (S-1).

( ) White-yellow to lug 2 (S-1).

( ) Connect the white-black wire from BO #4 to solder lug Y on the large light reflector (S-1).

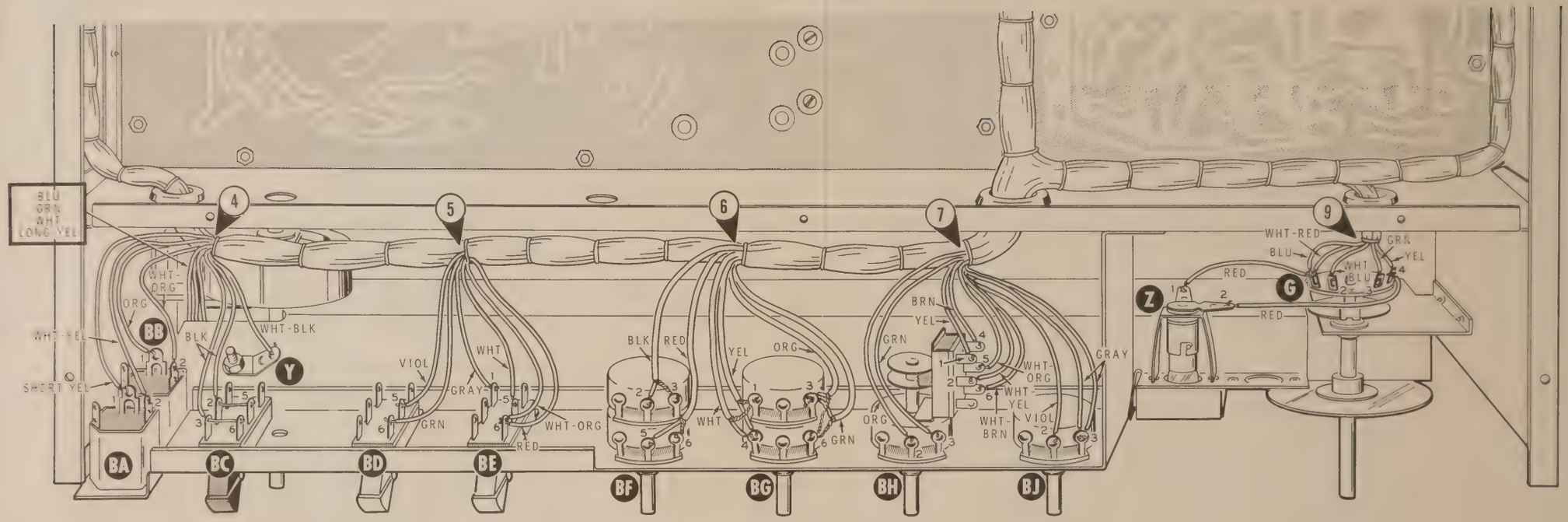
( ) Remove a total of 1/2" of insulation from each of the two black wires from BO #4.

Connect the wires from BO #4 to switch BC as follows:

( ) One black through lug 2 (S-2) to lug 5 (S-1).

( ) Other black through lug 3 (S-2) to lug 6 (S-1).

( ) Set the chassis aside temporarily.



PICTORIAL 3-9

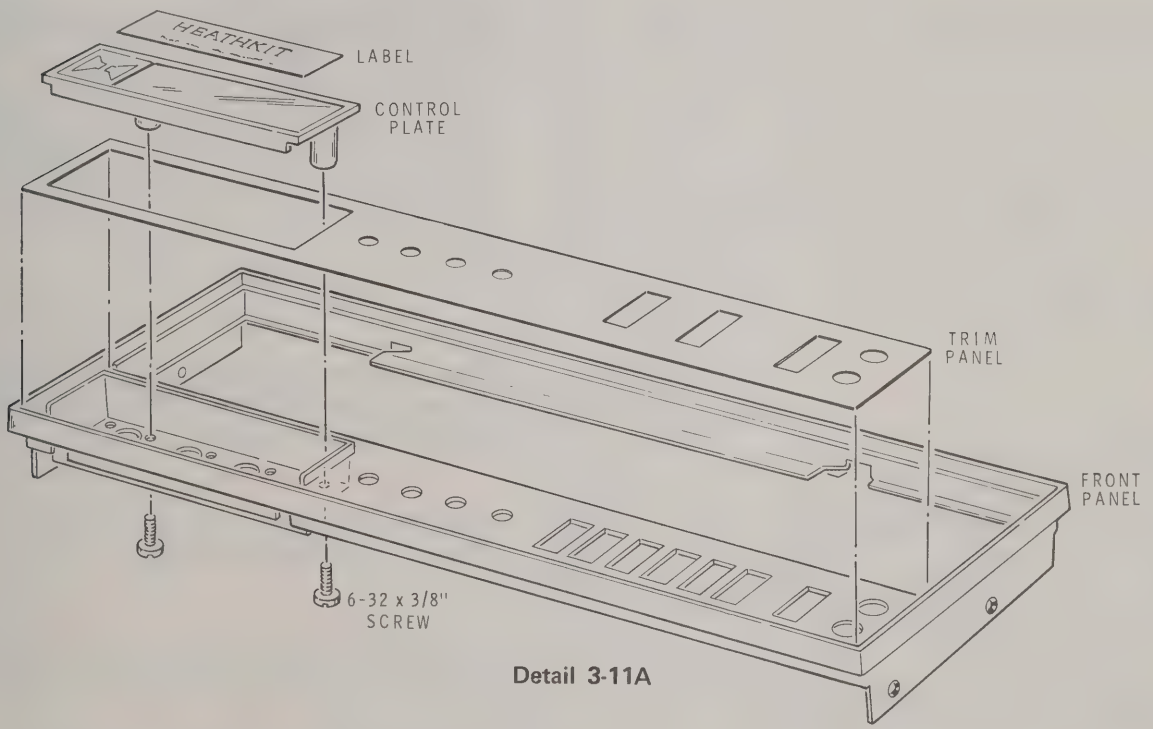
FRONT PANEL ASSEMBLY

Refer to Detail 3-11A for the following steps.

( ) Place the front panel on the soft cloth on your work area.

( ) If there is a thin plastic film covering the front of the trim panel, remove this plastic film.

( ) Remove the paper backing from the trim panel. Then press the trim panel into place as shown in the Detail. Be sure the control openings are aligned.



Detail 3-11A

( ) Mount the control plate with two 6-32 x 3/8" screws.

( ) Remove the paper backing from the door trim label and press it into position on the control plate.

DIAL WINDOW INSTALLATION

Refer to Pictorial 3-11 for the following steps.

( ) Cut a 16-3/8" length of foam tape. Peel away the backing paper and press the foam tape in place on the ridge of the front panel. Be sure to align the edge of the foam tape flush with the top edge of the ridge as shown in Part A of the Pictorial.

NOTE: Be careful not to scratch the black (back) surface of the dial window when performing the following steps.

( ) Place the dial window inside the opening in the front panel. Push the top edge in first, and then the bottom edge as shown in Part B of the Pictorial.

( ) Cut two 2-3/4" lengths of foam tape and peel away the backing paper. Make sure the dial window is pushed all the way back into the opening in the front panel. Then press the foam tape in place against the sides of the opening in the front panel as shown in Part C of the Pictorial.

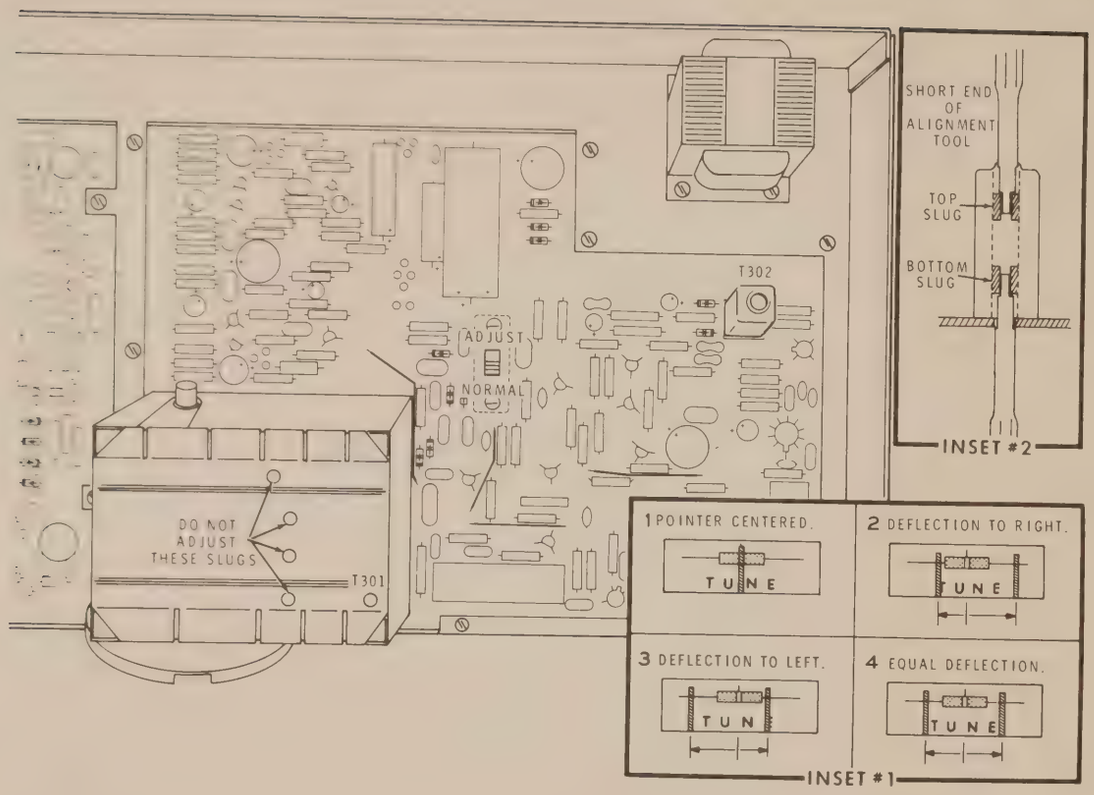
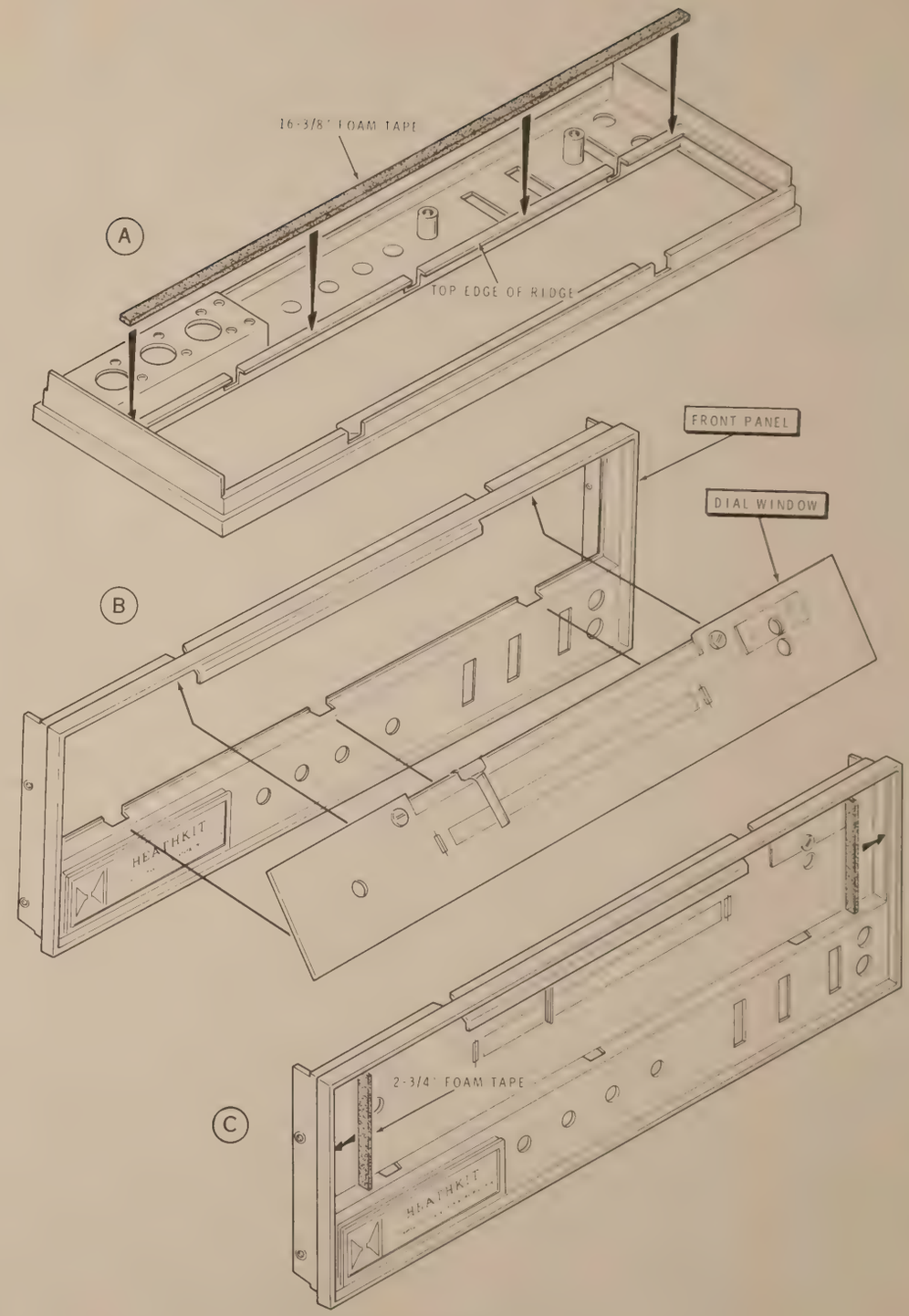


FIGURE 1-1



PICTORIAL 3-11

METER WIRING

Refer to Pictorial 3-12 for the following steps.

( ) Prop the front panel up in front of the chassis as shown in the Pictorial. This will make it easier to perform the following steps.

Connect the wires from BO #4, that extend through the slot in the large light reflector, to the meters in the following steps. NOTE: Cut the stripped ends of these wires to 1/8" before connecting them to the meters.

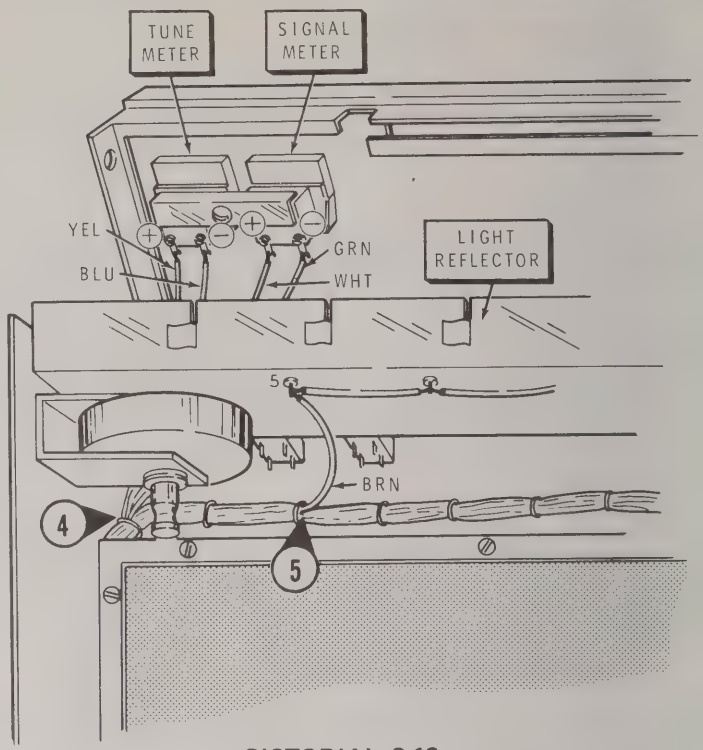
( ) Yellow to the positive (+) lug of the Tune meter (S-1).

( ) Blue to the negative (-) lug of the Tune meter (S-1).

( ) White to the positive (+) lug of the Signal meter (S-1).

( ) Green to the negative (-) lug of the Signal meter (S-1).

( ) Connect the brown wire from BO #5 to feed-through insulator 5 (S-2).



PICTORIAL 3-12

FRONT PANEL MOUNTING

Refer to Pictorial 3-13 for the following steps.

( ) Rotate the dial shaft clockwise until the tuning drum on the tuner assembly stops turning.

( ) Move the dial pointer to the right rectangular mark on the dial scale.

( ) Carefully fit the holes in the front panel over the control, switch, and dial shafts extending from the chassis. Then carefully place the dial cord over tab 2 of the pointer as shown in the inset drawing on the Pictorial. Hook the dial cord over tabs 1 and 3 of the dial pointer.

( ) As the front panel is being positioned back against the side aprons, feed the excess wires coming from the meters back under the chassis.

( ) Secure the front panel to the side aprons with four 6-32 x 3/8" black flat head screws.

( ) Refer to Detail 3-13A and fasten the control bracket to the front panel with two 6-32 x 1/4" screws.

( ) Check the operation of the dial pointer by turning the dial shaft. The dial pointer should stop at each end of the dial at equal distances from the retangular marks. Make any necessary adjustments by sliding the dial pointer on the dial cord. Be sure the dial pointer is straight up-and-down and does not rub on the dial window.

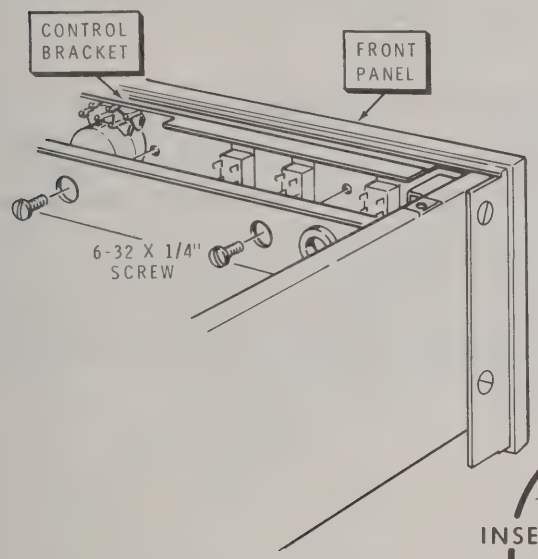
( ) Remove the paper backing from two felt washers. Push a washer on the switch shaft and tuning shaft as shown with the adhesive side against the dial window.

( ) Locate the tinted window. Wipe off any lint or dust from both sides of the window. NOTE: Any record cleaning fluid or diluted mild liquid detergent is ideal for cleaning the window.

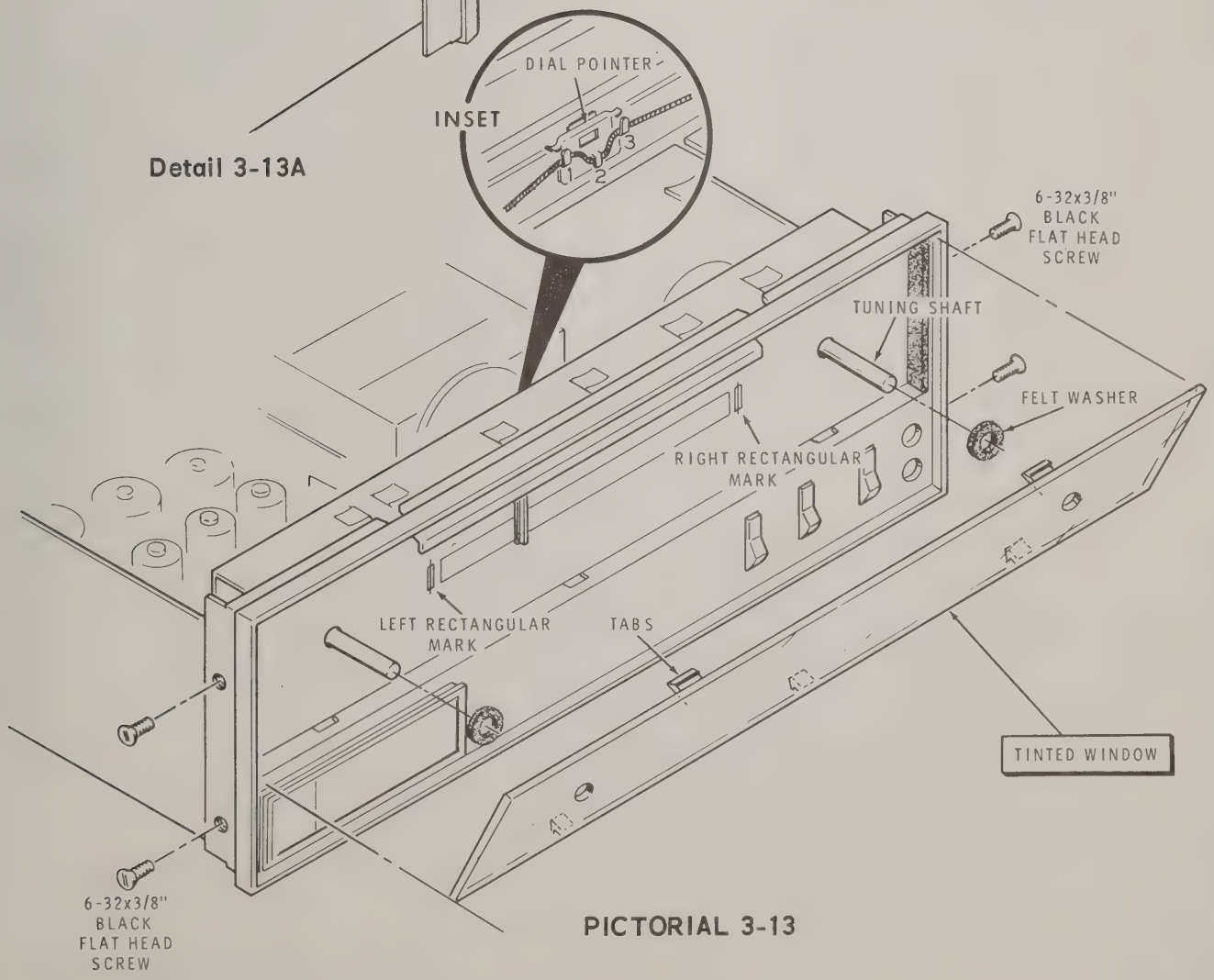
NOTE: When installing the tinted window in the next step, position it over the switch shaft and tuning shaft first. Then fit the bottom tabs of the window into the notches of the front panel. Complete the installation by pressing the top tabs into place.

( ) Install the tinted window in the opening of the front panel.

( ) Check to be sure the dial shaft is not binding. If it is, loosen the mounting screws of the tuning shaft bracket. Then make the necessary adjustment to free the tuning shaft and retighten the screws of the tuning shaft bracket.



Detail 3-13A



PICTORIAL 3-13

KNOB INSTALLATION

Refer to Pictorial 3-14 for the following steps.

( ) Remove the paper backing and place a felt washer on each of the following shafts; the switch shaft, the dial shaft and on each of the four control shafts. Press the adhesive side against the front panel.

( ) Install 8-32 x 7/16" setscrews in each of the two large knobs.

( ) Install large knobs on the switch shaft and dial shaft.

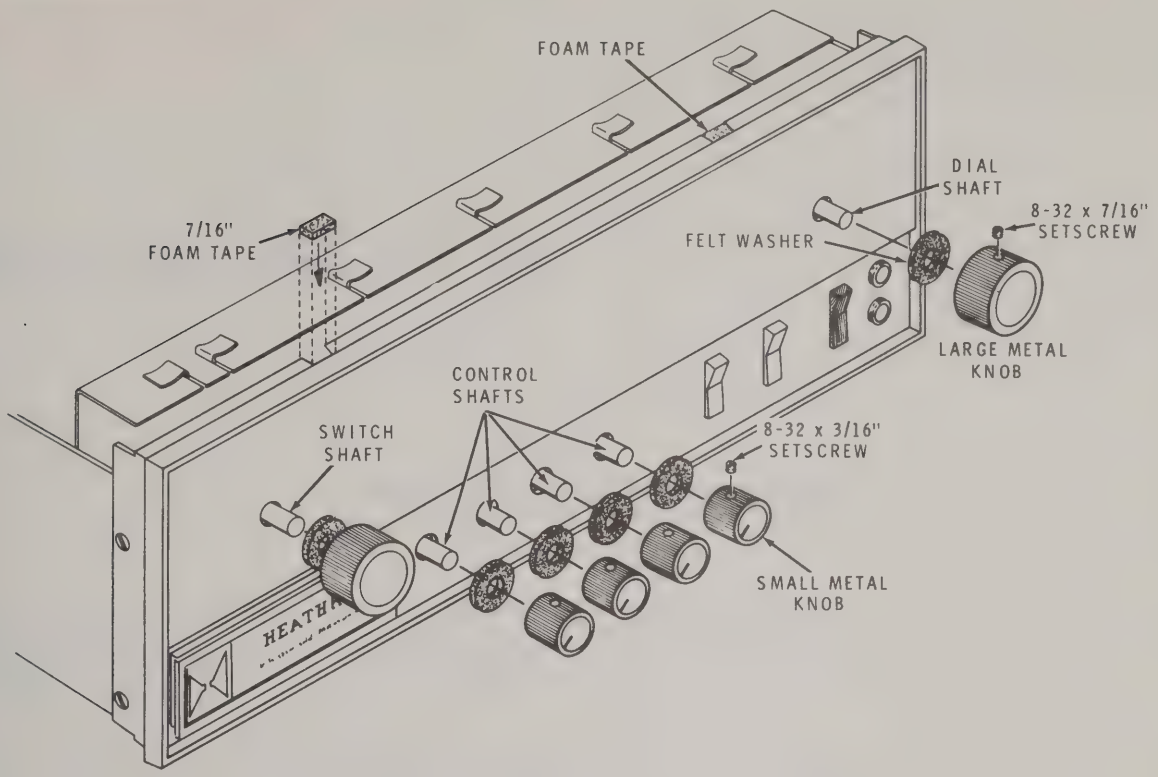
( ) Install 8-32 x 3/16" setscrews in the four small knobs.

( ) Rotate all four of the control shafts fully counterclockwise.

( ) Install the small knobs on the four control shafts. Position their pointers at the 7 o'clock position and tighten the setscrews.

( ) Cut two 7/16" lengths of foam tape and peel away the paper backing. Then press the tape in the two notches on the top edge of the front panel.

This completes the wiring of the Tuner. Check it carefully to see that all connections are soldered, (hole 21 on the multiplex circuit board is not used) and that no solder bridges exist between foils on the circuit boards. Shake out any wire clippings or solder splashes. Also, clip off any excess lengths of wire ends that extend above the circuit boards. These may short against component leads, coil lugs, etc., and prevent the Tuner from operating.



PICTORIAL 3-14

ADJUSTMENTS

FM ADJUSTMENTS

Very little adjustment, if any, will be required in the FM section of the Tuner. The following steps will help you check the FM section and make any adjustments that are necessary.

NOTE: The FM OSC, FM ANT, RF1 and RF2 adjustments in the FM tuning unit were pre-aligned at the factory. Therefore no further adjustment of these transformers and coils should be necessary. Furthermore, these adjustments can only be made with instruments and should only be performed by someone experienced with alignment procedures.

The following steps can be performed by connecting the Tuner to your stereo amplifier (with speakers) as shown in Figure 2-1 (Page 66), or by plugging stereo headphones into your Tuner.

( ) Connect an antenna to the antenna terminals of the Tuner. See Figure 2-3 on Page 67.

NOTE: You may wish to take a few minutes and read the information on Figure 3-1 (fold-out from Page 81) to familiarize yourself with the control functions and locations. This Figure can also be used for the setting of the controls in the following steps as the front panel lettering is not visible until the Tuner is turned on in a later step.

Set the front panel controls and switches as follows:

( ) Selector: MONO.

( ) SQUELCH: Fully counterclockwise.

( ) PHASE (push in): Center of rotation.

( ) BALANCE: Center of rotation.

( ) LEVEL: Fully counterclockwise.

( ) STEREO THRESH: MIN.

( ) NOISE FILTER: OFF.

( ) POWER: OFF.

( ) Place the slide switch on the FM circuit board to its NORMAL position.

NOTE: If the Tuner does not seem to operate properly during any of the following adjustments, turn it off immediately and refer to the In Case Of Difficulty section on Page 75.

Refer to Figure 1-1 (fold-out from Page 54) for the following steps.

( ) Turn the equipment on.

( ) Slowly turn the Tuning knob of the Tuner until only one station is heard. Find a station that causes a steady SIGNAL meter deflection between 1 and 4. NOTE: If headphones are used, it will be necessary to adjust the LEVEL control on the Tuner to a comfortable listening level.

( ) Observe the TUNE meter as you slowly turn the tuning knob to either side of the station. The TUNE meter should deflect an equal distance from the zero center mark as you tune from one side of the station signal to the other. See inset #1.

Perform the next step only if the TUNE meter does not deflect an equal distance to both sides of zero as you tune across the station signal.

Use the short end of the large alignment tool to make the following adjustments.

NOTE: Transformers T301 and T302, which will be adjusted in the following steps, have top and bottom adjustment slugs. The top slugs can be adjusted from the top of the Tuner and the bottom slugs from the bottom of the Tuner through the holes in the circuit board. See inset drawing #2 on Figure 1-1. Do not adjust the top slug of T302.

( ) Adjust the bottom slug of FM detector transformer T302 very carefully as you slowly turn the Tuning knob back and forth through the station signal. When the TUNE meter deflection is equal on both sides of zero, the bottom slug of T302 is properly adjusted.

( ) Tune in a station so the TUNE meter is centered at zero.

( ) Adjust the top slug of T301 (this coil is on the FM tuning unit) for a maximum deflection of the SIGNAL meter.

( ) Now adjust the bottom slug of T301 for a maximum deflection of the SIGNAL meter.

( ) Turn the POWER SWITCH to OFF.

This completes the adjustments on the FM circuit board. Proceed to the Multiplex Adjustments.

MULTIPLEX ADJUSTMENTS

The adjustments in the multiplex circuits will be made next. Refer to Figure 1-2 (fold-out from Page 65) for coil and TP (test point) locations.

( ) Change the Selector switch to the AUTO position. All other controls and switches should be set the same as for the FM Adjustments.

( ) Turn the Separation control on the multiplex circuit board fully clockwise; then counterclockwise 1/4 turn. See inset drawing #1 on Figure 1-2.

( ) Refer to inset drawing #2 on Figure 1-2, and set the arm of stereo threshold control R499 (located on the THRESH switch) to its fully counterclockwise position.

( ) Turn the Tuner ON.

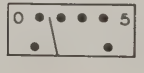
( ) Tune in an FM station, which is known to be broadcasting a stereo program, so the TUNE meter pointer is centered at zero. NOTE: The FM STEREO indicator light may not come on even through you may be receiving a stereo program.

( ) Set the slide switch (19 kHz switch) on the FM circuit board to its ADJUST position.

Use the screwdriver end of the small alignment tool to adjust coil L409 and transformers T401 and T402 in the following steps.

( ) Adjust the slug in coil L409 (no more than 1-1/2 turns in either direction) for a maximum indication on the SIGNAL meter. The FM STEREO indicator light should now be on.

( ) Now adjust the slug of coil L409 counterclockwise for a SIGNAL meter indication of 1-1/2 (half-way between the first two dots).



( ) Adjust the slug of transformer T402 for a maximum deflection on the SIGNAL meter.

( ) If the FM STEREO light is still on, turn the slug of coil L409 counterclockwise until the light just goes off.

( ) Press the POWER switch to OFF.

( ) Solder a 6" length of hookup wire from pin GND of coil L409 to TP1 on the circuit board.

( ) Press the Power switch to On. The FM STEREO light should now be lit.

In the following steps, the 38 kHz oscillator in the Tuner will be adjusted to the same frequency as the stereo subcarrier being broadcast by the FM station. If the oscillator and subcarrier are not at the same frequency, the audio will sound garbled on stereo stations. With a stereo station tuned in, a beat note will be heard in the background (because of the previous connection made between GND and TP1). NOTE: The beat note can be identified by a steady whistle. As the 38 kHz oscillator coil is adjusted, the whistle (beat note) will either go up or go down in pitch. The oscillator coil should be turned in a direction that causes the beat note to go down in pitch until the beat note disappears and the audio becomes clear.

( ) Pull the PHASE control knob "out" to its Adjust position.

( ) Tune in an FM stereo station. If it is difficult to detect the beat note, try another stereo station. NOTE: If no beat note is heard, slowly turn T401 in either direction until you hear the beat note.

( ) Adjust the slug of transformer T401 (no more than 1 turn) slowly until the beat note disappears and the audio becomes clear. Note the position of the slot in the slug of T401.

( ) Continue turning the slug slowly in the same direction as in the last step until the audio becomes garbled. Note the new position of the slot in the slug.

( ) Now turn the slug in T401 in the opposite direction so its slot is midway between the positions noted in the previous two steps.

( ) Turn the Tuner OFF.

( ) Remove the hookup wire previously installed between TP1 and the GND pin of coil L409.

( ) Connect this wire from TP2 on the circuit board to the 12 VOLTS pin on coil L409.

( ) Turn the Tuner ON.

If the audio is not garbled, the 38 kHz oscillator (T401) is adjusted properly and step 1 (only) below can be omitted. If it is still garbled, perform step 1.

NOTE: This is a fine adjustment and should be done very carefully. The point you will be instructed to find in the next step can be passed over very easily.

( ) 1. Turn the slug of T401 very slowly (no more than 1/4 turn) until the audio becomes clear.

( ) Turn the Tuner OFF.

( ) Remove the hookup wire from TP2 and the 12 VOLT pin on coil L409.

( ) Turn the Tuner ON.

( ) Turn the slug of coil L409 very slowly for a maximum indication on the SIGNAL meter.

( ) Return the 19 kHz slide switch (on the FM circuit board) to its NORMAL position. The SIGNAL meter will now indicate signal strength and will not be used for the rest of the Multiplex Adjustments.

( ) Turn the PHASE control fully counterclockwise. Then adjust coil L409 not more than 1/4 turn in either direction for maximum sound from the speakers (or headphones).

( ) Turn the PHASE control clockwise until a null (minimum sound) is reached in the sound level from the speakers. Then, without turning the control, push the knob in to the normal position.

The next two steps are for the optimum setting of the SEPARATION control. However, because this adjustment can be performed only while receiving a station that is broadcasting on only one channel, it is not always possible to make the adjustment. If you cannot locate a station broadcasting on only one channel, disregard the next two steps and leave the SEPARATION control in its present position.

NOTE: Some stations frequently provide stereo checks, in which they broadcast for a few moments on one channel, and then on the other. Also, some stations will broadcast the news on only one channel.

( ) Pull out the PHASE control knob and adjust the control for a null (minimum sound) in the sound level from the speakers. Then, without turning the knob, push the knob back in.

( ) Adjust the SEPARATION control, on the multiplex circuit board, for the minimum sound output from the unused channel. NOTE: To aid in making this adjustment, the BALANCE control can be set so that only the unused channel is heard.

The setting of the Stereo Threshold control (see the inset drawing #2 on Figure 1-2) determines the noise level that will automatically switch the Tuner from stereophonic to monophonic operation when the THRESH switch is in the MIN (minimum) position.

( ) Tune to a spot on the dial where no station is heard and just noise is available. The STEREO light should come on.

( ) Adjust the stereo Threshold control clockwise until the FM STEREO light goes out. Now only FM stereo stations with a noise level below this threshold level setting will be heard in stereo. All other stations will be heard monophonically.

( ) Change the Selector switch to the STEREO position.

( ) As you tune across the dial, check to see that only stereo stations are heard. Monophonic stations will be indicated on the meters, but should not be heard.

( ) Return the Selector switch to its AUTO position.

( ) Tune in an FM station near 98 MHz on the dial. Check the frequency of the station as listed in a newspaper, or announced during a station break. Then hold the dial string pulley so it cannot move and slide the dial pointer to the station number.

( ) Turn the Tuner OFF.

Access to the dial pointer is available in the opening between the front panel and the large light reflector.

This completes the Multiplex Adjustments. Do not adjust any other coils on the multiplex circuit board at this time. Special equipment is required for these other adjustments, as described in the Alignment section of the Manual.

FINAL ASSEMBLY

NOTE: If the Tuner is to be custom mounted or installed in the Heath Accessory Cabinet, complete steps 3, 4, 5, and 6 only and refer to Part B of Pictorial 4-1. If the Tuner is to be placed on a shelf or a similar location, complete steps 1 through 6 and refer to Parts A and B of Pictorial 4-1.

1. ( ) Position the bottom plate with holes CA, CB, and CC as shown. NOTE: The bottom plate is perforated with ventilation holes. However, the mounting holes can be identified by their larger diameter.

2. ( ) Mount the four plastic feet on the bottom plate with 6-32 x 3/8" screws and 6-32 nuts. NOTE: Do not use the mounting holes indicated by the arrows in the Pictorial.

3. ( ) Peel away the protective backing paper from the insulator sheet (adhesive back). Press the sheet in place on the inside of the bottom plate as shown in the inset drawing #2 on the Pictorial.

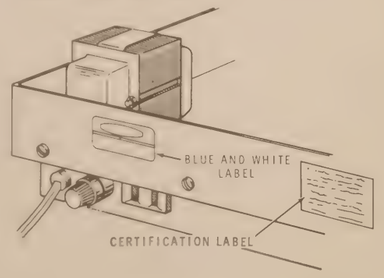
4. ( ) Place the Tuner upside down on your work surface as shown and install the four 6-32 speednuts on the chassis at the locations shown. See inset drawing #1. Be sure to position the flat side up.

5. ( ) Place the bottom plate on the bottom of the Tuner with holes CA, CB, and CC positioned as shown.

6. ( ) Install #6 x 1/4" sheet metal screws only in the six holes shown.

( ) Carefully peel away the backing paper from the blue and white label. Then press the label onto the rear of the Tuner at the location shown in Detail 4-1A. Be sure to refer to the numbers on this label in any communications you have with the Heath Company about this kit.

( ) Date and sign the Certification label. Then carefully peel away the backing paper and press the label onto the rear of the tuner as shown in Detail 4-1A.



Detail 4-1A

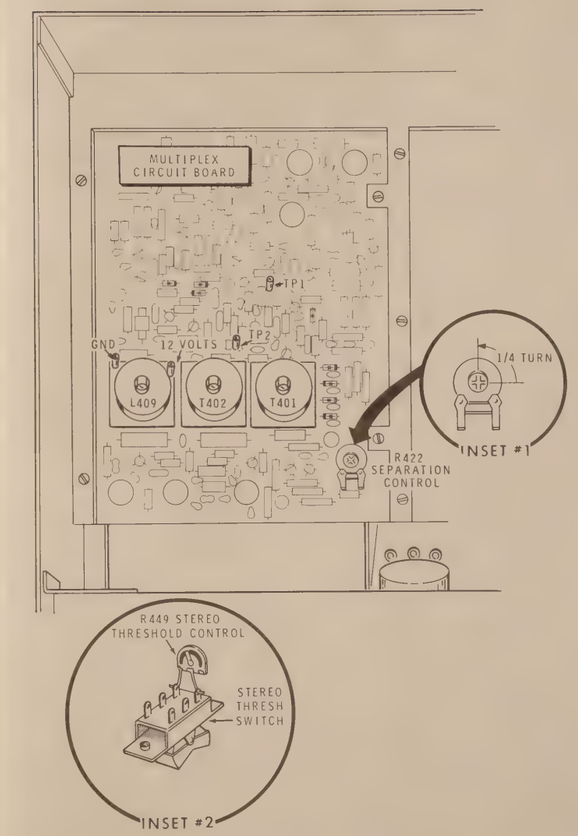
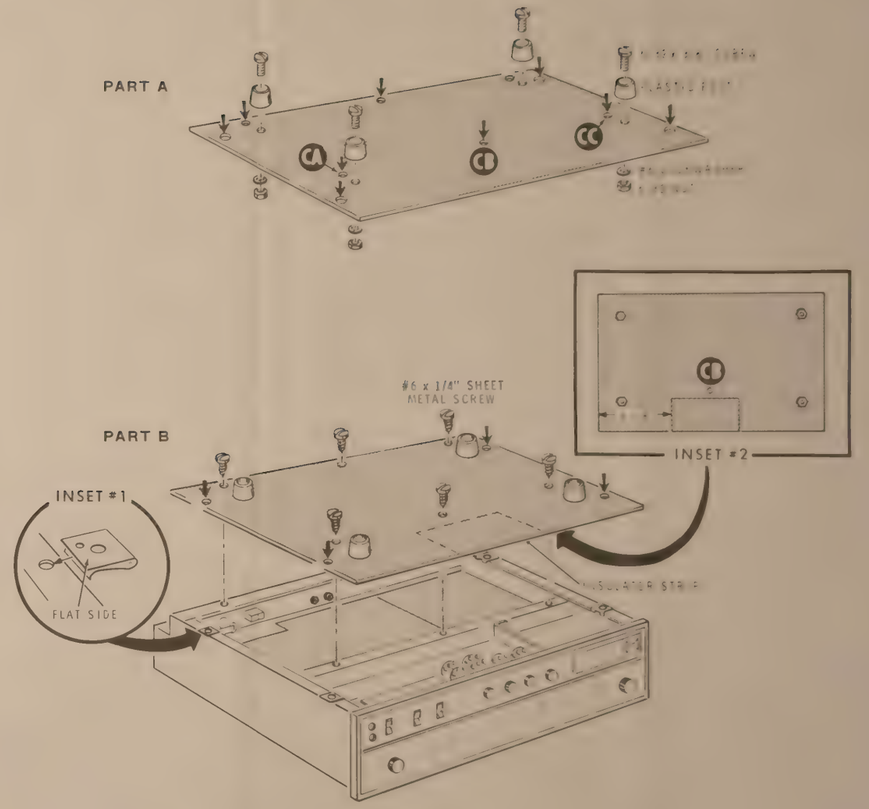


FIGURE 1-2



PICTORIAL 4-1

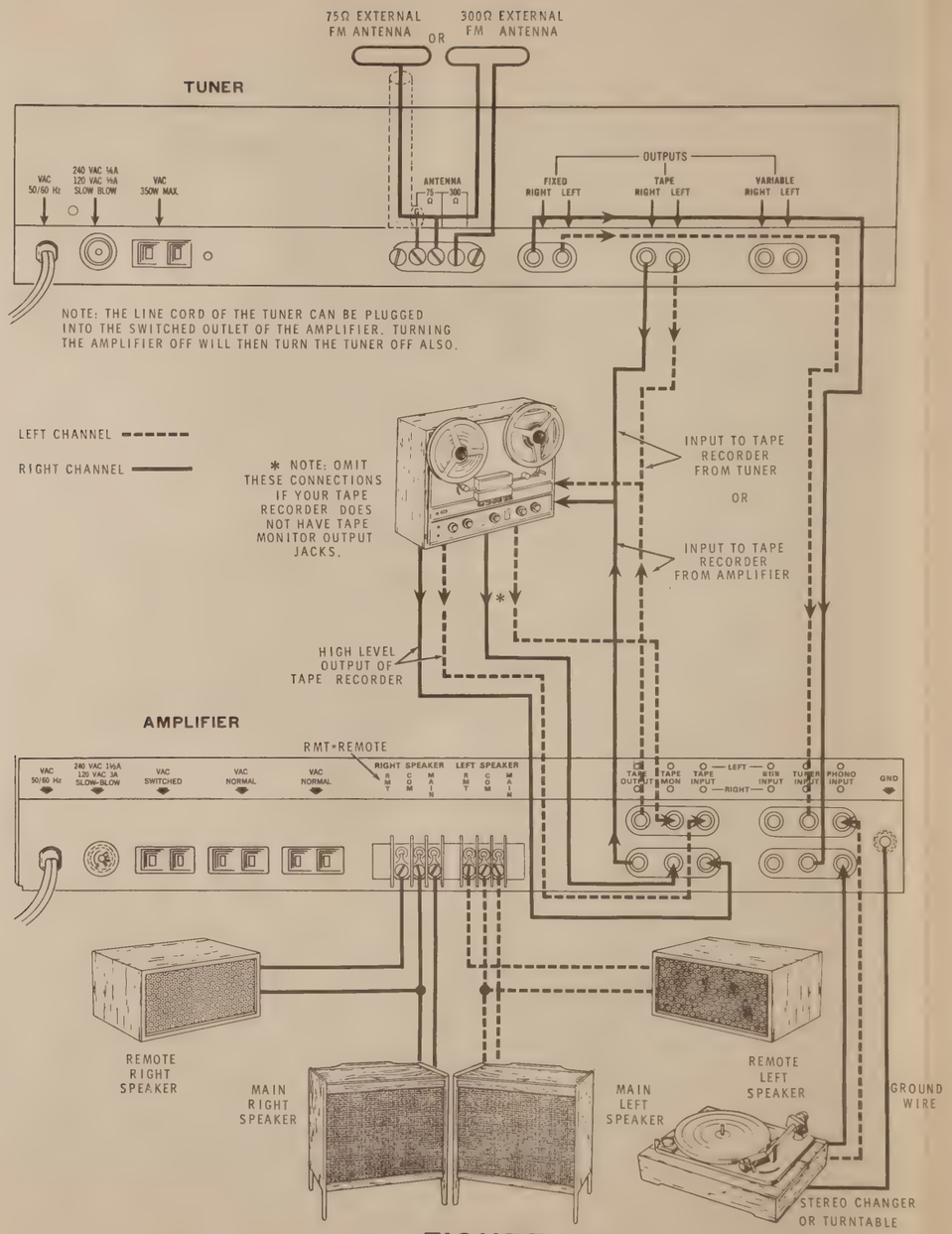

75Ω EXTERNAL FM ANTENNA
OR
300Ω EXTERNAL FM ANTENNA
TUNER
VAC 50/60 Hz
240 VAC 1¼A 120 VAC 1¼A SLOW BLOW
VAC 350W MAX.
ANTENNA 75Ω 300Ω
OUTPUTS
FIXED RIGHT LEFT
TAPE RIGHT LEFT
VARIABLE RIGHT LEFT
NOTE: THE LINE CORD OF THE TUNER CAN BE PLUGGED INTO THE SWITCHED OUTLET OF THE AMPLIFIER. TURNING THE AMPLIFIER OFF WILL THEN TURN THE TUNER OFF ALSO.
LEFT CHANNEL
RIGHT CHANNEL
* NOTE: OMIT THESE CONNECTIONS IF YOUR TAPE RECORDER DOES NOT HAVE TAPE MONITOR OUTPUT JACKS.
INPUT TO TAPE RECORDER FROM TUNER
OR
INPUT TO TAPE RECORDER FROM AMPLIFIER
HIGH LEVEL OUTPUT OF TAPE RECORDER
AMPLIFIER
RMT=REMOTE
VAC 50/60 Hz
240 VAC 1½A 120 VAC 3A SLOW-BLOW
VAC SWITCHED
VAC NORMAL
VAC NORMAL
RIGHT SPEAKER RMT COM MAIN
LEFT SPEAKER RMT COM MAIN
TAPE OUTPUT
TAPE MON
LEFT
TAPE INPUT
RIGHT
STR INPUT
TUNER INPUT
PHONO INPUT
GND
REMOTE RIGHT SPEAKER
MAIN RIGHT SPEAKER
MAIN LEFT SPEAKER
REMOTE LEFT SPEAKER
GROUND WIRE
STEREO CHANGER OR TURNTABLE

FIGURE 2-1

INSTALLATION

SYSTEM CONNECTIONS

Refer to Figure 2-1 (fold-out from Page 66) before you connect the antenna, amplifier, or tape recorder to your Tuner.

PHONE JACKS

Figure 2-2 shows the type of plug that should be installed on the end of a stereo headphone cable. The tip connection of the plug connects to the right channel wire, the ring connects to the left channel wire, and the sleeve connects to the common connections.

INDOOR ANTENNAS

Several types of indoor TV and FM antennas are available that will provide satisfactory mono FM operation of the Tuner in strong signal areas, or from strong local stations. For stereo FM however, an outdoor antenna should be used.

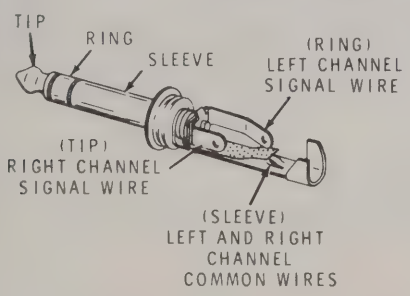


Figure 2-2

A simple folded dipole antenna can be made as shown in Figure 2-3, from VHF 300 Ω twin lead. This antenna can be placed on the rear of a large cabinet or nailed or stapled to a piece of wood to reinforce it. Best reception will be obtained from the stations that are broadside to this antenna. Weakest reception will occur with those stations that face the ends of the antenna.

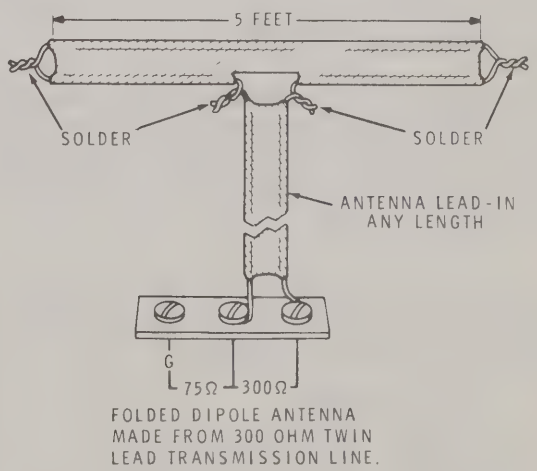


Figure 2-3

OUTDOOR ANTENNAS

To receive stations in weak signal areas, an outdoor antenna will be necessary. BEST RECEPTION FOR STEREO FM WILL OCCUR WITH A COMMERCIAL FM OUTDOOR ANTENNA. A VHF TV antenna can also be used as an FM antenna since FM station frequencies are actually located between TV channnels 6 and 7.

Do not connect a TV antenna to both the TV set and the Tuner at the same time, unless a TV antenna coupler is used, or a weak and distorted signal may occur in both units. Pad type couplers are not recommended because large amounts of signal are lost in them. Use a preamplifier type of coupler instead, where there is no loss of signal.

MULTI-PATH SIGNALS

FM or FM stereo signals sometimes become noisy or distorted because they are reaching your antenna from several directions at the same time. See Figure 2-4. These multi-path signals are usually reflected from objects such as large buildings or large metal structures. This type of distortion can usually be eliminated or minimized by turning your antenna until it is receiving only one of these signals.

Unwanted reflected signals may also be picked up on your antenna lead-in wire in strong signal areas. To eliminate this condition, connect your antenna lead-in to the antenna terminal strip as shown in Figure 2-5 or 2-6.

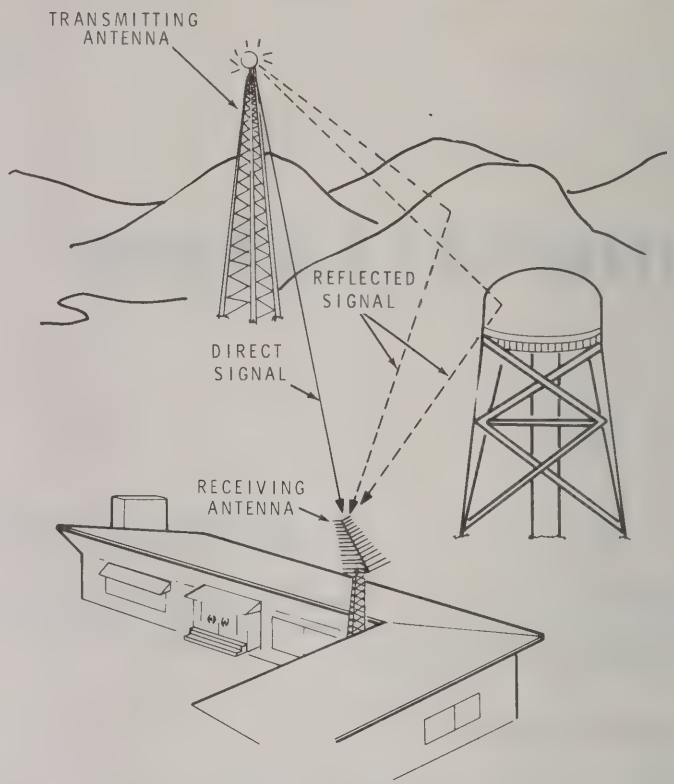


Figure 2-4

OUTPUT CONNECTIONS

Shielded cables, terminated in standard phono plugs, should be used for all output (except headphone outlet) signal connections from your Tuner.

AC OUTLET

For supplying power (350 watts maximum) to devices such as tape decks.

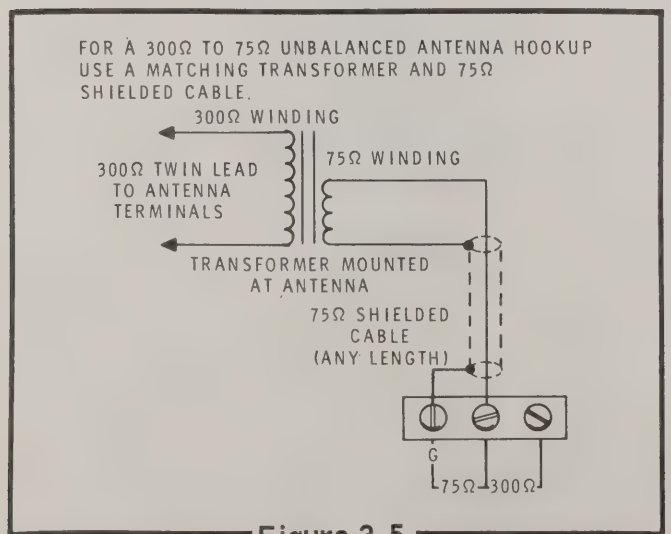


Figure 2-5

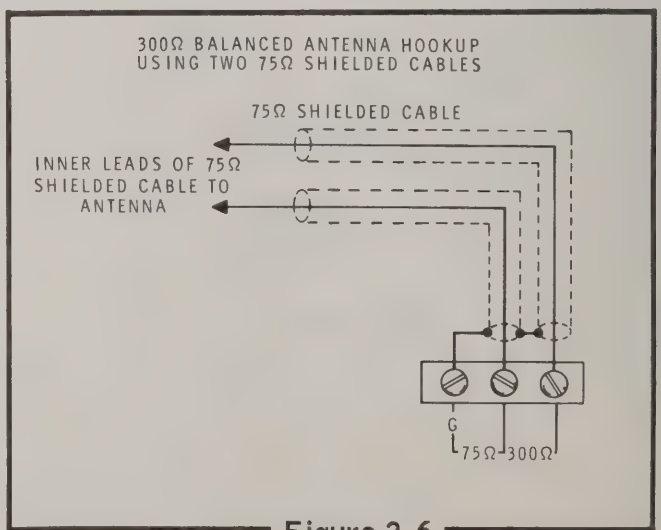


Figure 2-6

MOUNTING THE TUNER

This Tuner may be installed in the Heathkit Model AE-18 Cabinet, or it may be custom mounted in your present cabinetry or wall paneling. Instructions are given for both types of installation on the following pages. Use only the instructions that apply to your situation.

AE-18 CABINET INSTALLATION

Refer to Figure 2-7 for the following steps.

( ) Locate the four plastic feet supplied with the Cabinet, and the four 6-32 x 3/4" self-tapping screws and the four #6 flat washers that were furnished with the Tuner. Then install the cabinet on the Tuner as follows:

( ) Place a soft cloth on your work area. Then place the cabinet upside down on the cloth.

( ) Carefully remove the backing paper from a plastic foot. Then install the foot on the bottom of the Cabinet in line with the countersunk holes, according to the dimensions shown. Press the foot firmly into position.

( ) In a similar manner, install plastic feet at the other three corners.

Refer to the inset drawing on Figure 2-7 for the next two steps.

( ) Install the plastic trim strip, supplied with the cabinet, on the turned-up edge of the ventilating louver at the rear of the cabinet top (see inset drawing). Start at one end and press the trim strip into position along the entire length of the louver.

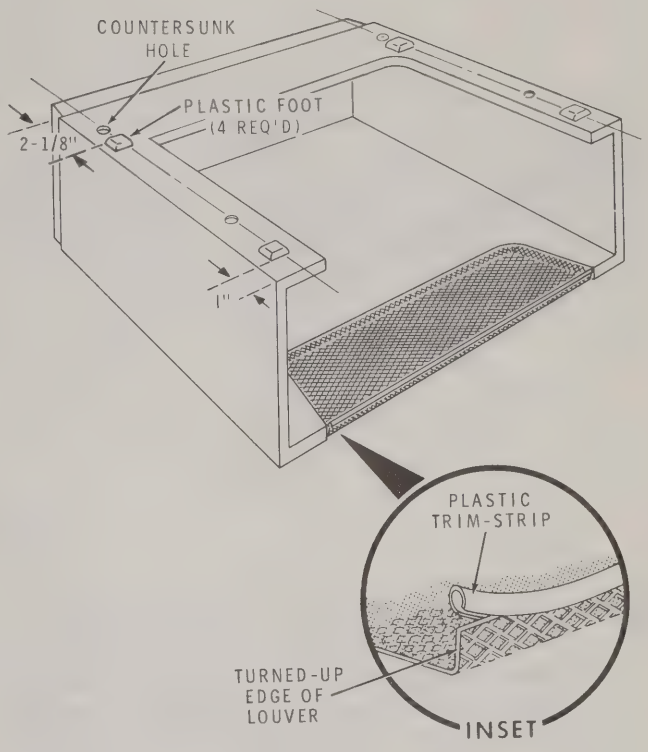


Figure 2-7

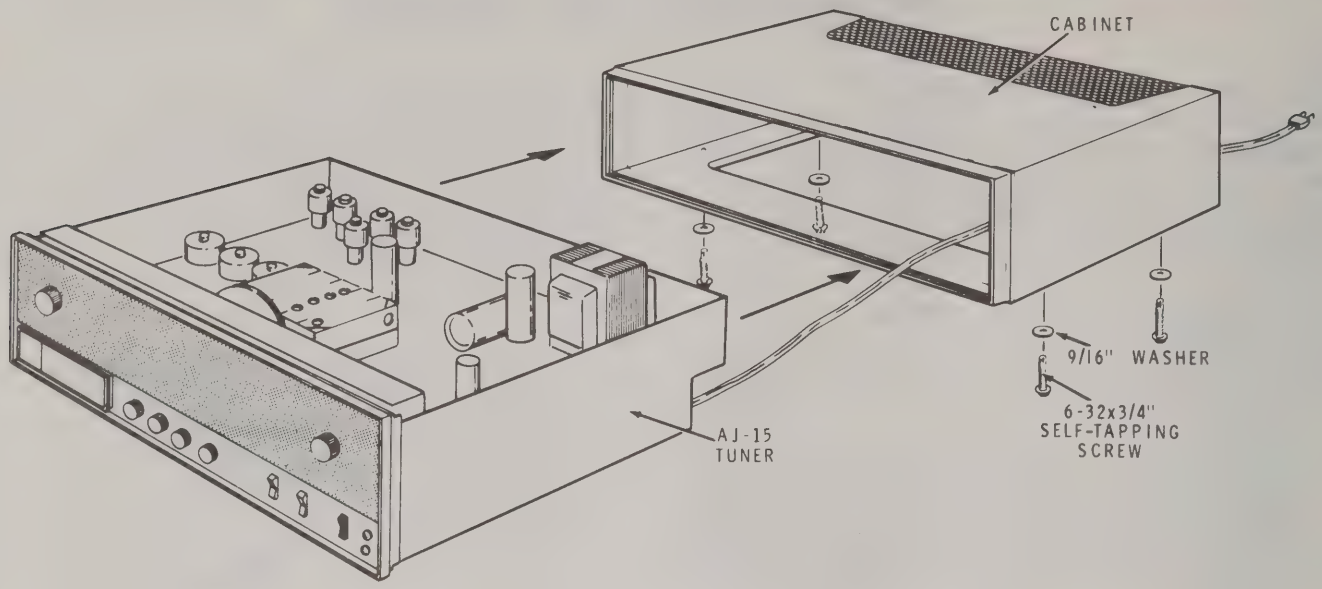


Figure 2-8

Refer to Figure 2-8 for the following steps.

( ) Place the cabinet on your work surface. Pass the line cord through the cabinet and insert the rear of the Tuner through the opening in the front of the cabinet. Slide the Tuner into the cabinet as far as it will go.

( ) Position one side of the Tuner over the edge of the work bench. Then fasten the cabinet to the chassis with two 6-32 x 3/4" self-tapping screws and two 9/16" washers. Repeat this procedure with the other side.

This completes the Cabinet installation.

CUSTOM INSTALLATION

When planning your custom installation, keep in mind that the Tuner requires adequate ventilation and that the input sockets, antenna connection and the AC outlet on the rear of the chassis must be accessible. The connecting cables should be long enough so they can be connected or disconnected when the Tuner is removed from its installed position.

Figure 2-9 shows a typical installation in a wall or panel. The Figure shows the dimensions of the panel cutout and the depth required behind the panel. The mounting board should be cut out to allow adequate ventilation through the holes in the Tuner bottom plate. The method you use to secure the mounting board to the panel or wall area will depend upon the specific conditions you encounter in your installation.

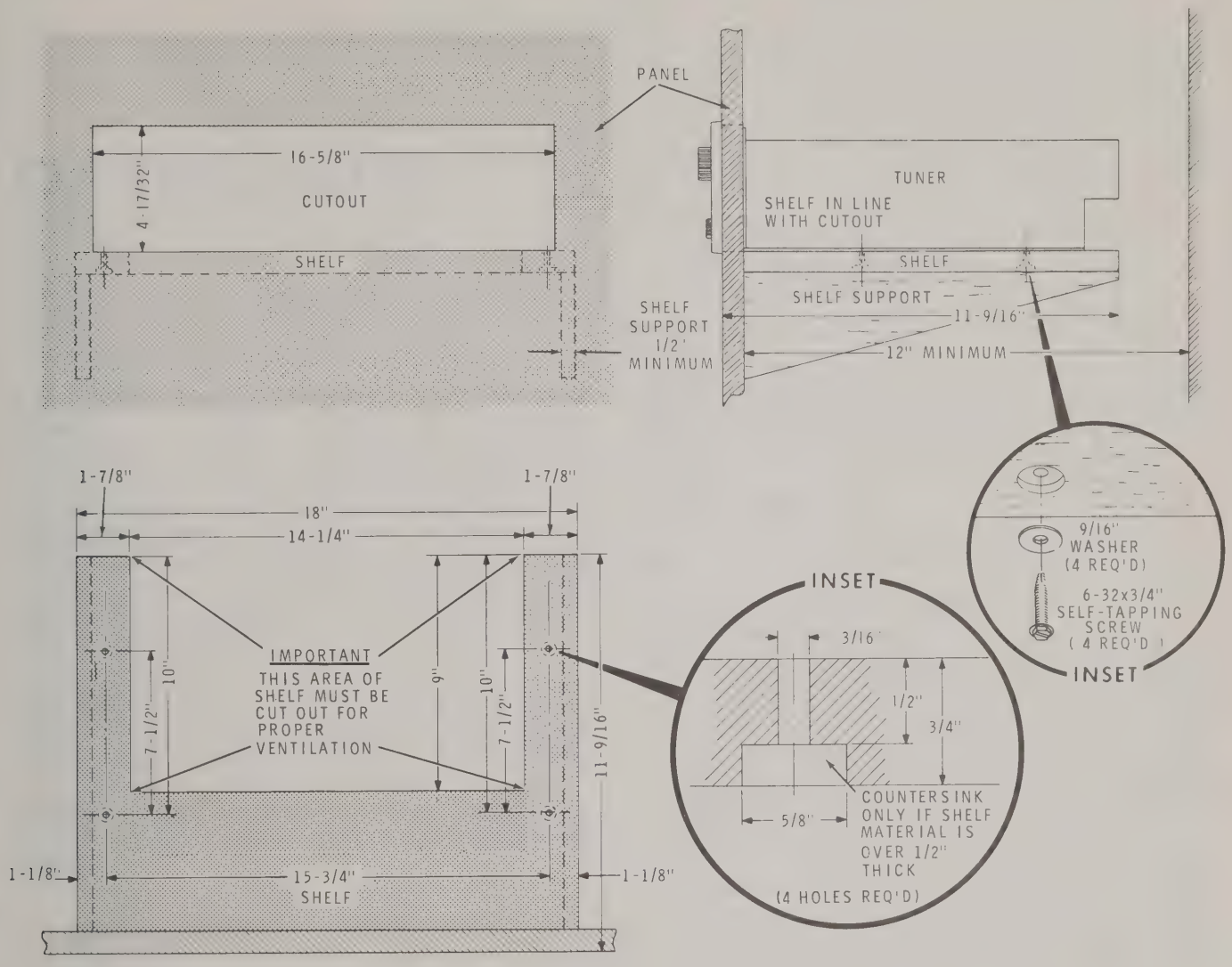

PANEL
16-5/8"
4-17/32"
CUTOUT
SHELF
SHELF SUPPORT 1/2" MINIMUM
TUNER
SHELF IN LINE WITH CUTOUT
SHELF
SHELF SUPPORT
11-9/16"
12" MINIMUM
9/16" WASHER (4 REQ'D)
6-32x3/4" SELF-TAPPING SCREW (4 REQ'D)
INSET
1-7/8"
1-7/8"
18"
14-1/4"
IMPORTANT
THIS AREA OF SHELF MUST BE CUT OUT FOR PROPER VENTILATION
10"
7-1/2"
9"
10"
7-1/2"
11-9/16"
1-1/8"
15-3/4"
SHELF
1-1/8"
INSET
3/16"
1/2"
3/4"
5/8"
COUNTERSINK ONLY IF SHELF MATERIAL IS OVER 1/2" THICK
(4 HOLES REQ'D)

Figure 2-9

OPERATION

The Tuner can be operated from either a 105-125, or 210-250 volt 50/60 Hz AC source (depending on how the power transformer is wired). All controls are clearly marked and are accessible from the front. Connections to the antenna and auxiliary equipment are clearly marked and are made at the rear of the chassis. NOTE: The AC socket will supply the same voltage that is present at the wall receptacle (120 VAC or 240 VAC).

The Normal Operation Program Reproduction Chart (Page 74) shows the type of audio output signal obtained from different switch settings.

Refer to Figure 3-1 (fold-out from Page 81) and preset the front panel controls and switches as follows:

( ) Selector: MONO.

( ) SQUELCH: Fully counterclockwise.

( ) PHASE: Fully counterclockwise.

( ) BALANCE: Center of rotation.

( ) LEVEL: Fully counterclockwise.

( ) STEREO THRESH: MAX.

( ) NOISE FILTER: OFF.

( ) POWER: OFF.

NOTE: The LEVEL control would only be increased in the event that the Tuner is used with headphones, or if the VARIABLE output was connected to a power amplifier having no volume or level control.

The following instructions tell you how to tune in monophonic and stereophonic FM stations to obtain the best reception.

MONOPHONIC FM

Refer to Figure 3-1 for the following steps.

( ) Turn the equipment ON.

( ) Tune in an FM station. Adjust the Tuning knob until the pointer on the TUNE meter is at the center line between the dark areas of the meter scale. NOTE: Because of the high sensitivity of the Tuner and the quality of the FM stations available for listening, it is possible to locate two stations that are quite close together (200 kHz). When this happens, it may be better to tune away from the adjacent station slightly for better listening. The pointer of the TUNE meter will then not be at the center line as described earlier.

( ) Now tune off-station until noise is heard. Then turn the SQUELCH control clockwise just enough to eliminate the between-station noise.

( ) Tune across the dial to check the effectiveness of the squelch action. The SQUELCH control may have to be turned off (fully counterclockwise) to receive very weak stations. As this control is turned clockwise, only the strongest stations are heard. It is not necessary to adjust the SQUELCH control each time you tune in a station.

If high frequency noise is present when a station is tuned in correctly, place the NOISE switch in the ON position. This will reduce the high frequency noise.

STEREOPHONIC FM

NOTE: The FM STEREO lamp will light only when an FM stereo station is tuned in. This lamp will not light when monophonic FM stations are tuned in.

( ) Place the Selector switch in the AUTO position.

( ) Tune across the dial until the FM STEREO lamp lights, indicating an FM stereo signal. Adjust the Tuning knob until the station is tuned in correctly with the pointer of the TUNE meter at the scale centerline.

( ) Pull out the PHASE control. Adjust this control for minimum sound; then push the control back in. This adjustment assures you of maximum separation between the two channels.

NOTE: When an FM stereo transmission is received, the FM STEREO lamp will light. However, if the station should play a monophonic recording while broadcasting in stereo, there would be no stereo sound from your speaker systems and the PHASE control cannot be set.

You may want to place the Selector switch in the STEREO position. In this position, only signals from stations broadcasting FM stereo will be heard.

( ) Place the STEREO THRESH switch in the MIN position to receive the maximum number of stereo stations. For best listening, place the STEREO THRESH switch in the MAX position. In this position, the Tuner will tune in only FM stereo stations with a noise level below the threshold level setting of the Threshold control (R499).

TAPE RECORDER

The audio signal from any station tuned in on the Tuner is present at the TAPE output jacks and can be recorded by any suitable tape recorder.

HEADPHONES

The audio signal from any station tuned in on the Tuner is present at the PHONES output jacks and can be heard on any suitable stereo headphones. The LEVEL control on the Tuner can be set for the desired listening level.

NORMAL OPERATION REPRODUCTION CHART

This chart shows the type of audio output signal that you will obtain with different combinations of switch settings.

SOURCE SWITCH SETTING	PROGRAM MATERIAL	STEREO THRESH affect on output (See Notes)	FM STEREO LAMP IS:	AUDIO OUTPUT SIGNAL WILL BE:	NOTES:
MONO	Monophonic or Stereophonic	No effect	OFF	Monophonic-both channels	The threshold circuit automatically switches the multiplex circuits from stereophonic to monophonic operation if the stereo signal becomes too noisy. NOTE: Read the section on Multi-path Signals on Page 68 for additional information on noise and distortion. The threshold circuits do not react to the type of noise or distortion that is characteristic to Multi-path signals. Condition 1 - Low noise level = Multiplex circuits will pass a stereophonic signal. Condition 2 - High noise level = Multiplex circuits switched over to monophonic operation.
AUTO	Monophonic	No effect	OFF	Monophonic-both channels	
	Stereo	Condition 1	ON	Stereophonic-left and right channel	
	Stereo	Condition 2	OFF	Monophonic-both channels	
STEREO	Monophonic	No effect	OFF	No audio output	
	Stereo	Condition 1	ON	Stereophonic-left and right channel	
	Stereo	Condition 2	OFF	No audio output	

IN CASE OF DIFFICULTY

NOTE: Refer to inside the front and rear covers for Warranty and Service information.

INTRODUCTION

This section of the Manual provides you with information that will help you locate and correct any difficulty that might occur in your Tuner. This information is divided into three sections. The first section contains suggestions of a general nature in the following areas.

A. Visual checkover and inspection (Visual Tests).

B. Precautions to observe when bench testing.

The second section consists of the Troubleshooting Charts. These charts call out specific problems that could occur and lists one or more conditions or components that could cause each problem. The resistor R numbers, capacitor C numbers, coil and transformer L and T numbers, and the test point numbers, are identified in these charts by the same numbers that are used on the Schematic Diagram. X-Ray Views (Page 105) and a Photograph (Page 109) are also provided to help you locate these components.

The third section consists of Stage-By-Stage Signal Injection (hum) tests in chart form for the audio stages of the Tuner. These tests are arranged in numerical order starting with the audio output circuits and progressing back through the audio circuits one stage at a time.

GENERAL SECTION

VISUAL TESTS

1. About 90% of the kits that are returned for repair do not function properly due to poor connections and soldering. Therefore, many troubles can be eliminated by a careful inspection of connections to make sure they are soldered as described in the Soldering section of the Kit Builders Guide. Reheat any doubtful connections and be sure all the wires are soldered at places where several wires are connected.

2. Check to be sure that all transistors are in their proper locations and installed correctly.

3. Check the values of the parts. Be sure that the proper part has been wired into the circuit for each step, as shown in the Pictorial diagrams and as called out in the wiring instructions. It would be easy, for example, to install a 2200 Ω (red-red-red) resistor in a step that calls for a 220 Ω (red-red-brown) resistor.

4. Recheck the wiring. Trace each lead in colored pencil on the Pictorial as it is checked. It is frequently helpful to have a friend check your work. Someone who is not familiar with the unit may notice something you have consistently overlooked.

5. Check all wires connected to the circuit boards. Make sure the wires do not extend through the circuit board and make contact with other connections or parts, such as coil lugs or component leads.

6. If the difficulty still is not cured, read the Precautions For Bench Testing section, and the section entitled How To Troubleshoot Your Tuner. Refer to the Service section of the Kit Builders Guide if you are unable to resolve the difficulty and need assistance from the Technical Consultation Department of the Heath Company.

PRECAUTIONS FOR BENCH TESTING

1. Be cautious when testing transistor circuits. Although transistors have almost unlimited life when used properly, they are much more vulnerable to damage from excessive voltage or current than tubes. A vacuum tube can often be operated under shorted, zero-bias, excessive-voltage, or high-current conditions for short periods of time without materially damaging the tube. Any one of these same conditions can completely destroy a transistor instantly.

2. Be sure you do not short any terminals to ground when making voltage measurements. If the probe should slip, for example, and short out a bias or voltage supply point, it is almost certain to cause damage to one or more transistors or diodes.

3. Do not remove transistors while the Tuner is turned on, since this could damage the transistor.

CAUTION: The full AC line voltage is present at several points (fuseholder, AC socket, On/Off switch etc.) in the power supply circuit of the Tuner. Be careful to avoid personal shock when performing the checks described.

HOW TO TROUBLESHOOT YOUR TUNER

If you know which area your trouble is in, apply the Visual Tests listed, to that area.

You may also go directly to the Troubleshooting Charts to see if the difficulty you are having is listed in one of the "Condition" columns. If your difficulty is listed here, check the Possible Causes listed for that item and apply the Visual Tests listed, to the Area of Difficulty.

If you cannot resolve your problem in the amplifier stages with the Troubleshooting Charts, refer to the Stage-By-Stage Signal Injection tests, beginning on Page 82. Perform these tests as directed. First, they will lead you to the area your trouble is in. When you have localized your trouble down to one area, check the Possible Causes listed for that area.

REPAIRING THE TUNER

When you make repairs to your Tuner, make sure you eliminate the cause as well as the effect of the trouble. If, for example, you should find a burned (overheated) resistor, be sure you find out what it was (wiring error, etc.) that caused the resistor to burn. If the cause was not eliminated, the replaced resistor would also burn up when the Tuner was put back into operation.

SHIPPING INSTRUCTIONS

NOTE: If the Tuner is sent back to the Factory for repair, do not send the cabinet (if one was purchased). The cabinet is not necessary for shipping and could be damaged enroute. Complete shipping instructions can be found in the Kit Builders Guide.

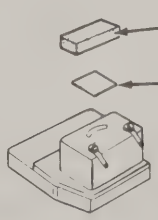
TROUBLESHOOTING CHARTS

The Troubleshooting Charts on the following pages list specific difficulties that could occur in your Tuner. Several possible causes are listed for each difficulty.

Refer to the X-Ray Views of the circuit boards (Page 105), the Chassis Photograph (Page 109), and the Schematic (fold-out from Page 115) to locate and identify the parts listed in these charts.

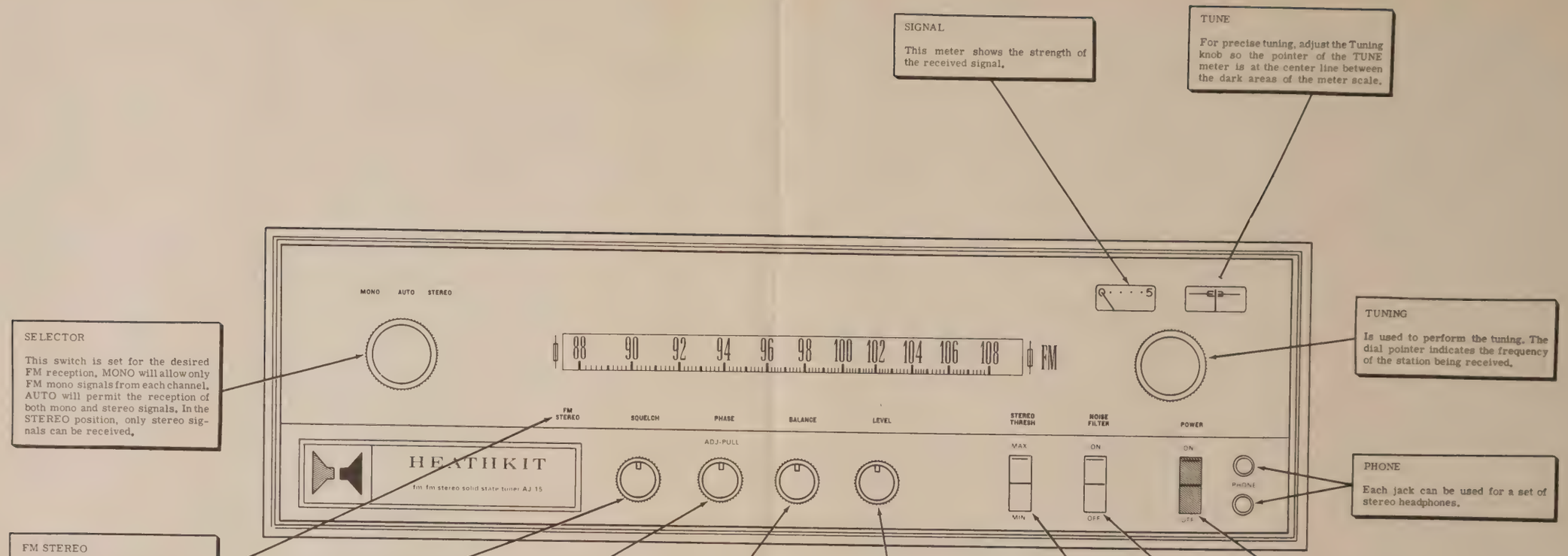
TUNER FM CIRCUITS (Monophonic)

TEST No.	CONDITION	AREA OF DIFFICULTY	POSSIBLE CAUSE
1.	FM reception weak and noisy.	External. Not in Tuner.	1. Poor or shorted FM antenna connections. 2. FM antenna lead-in open between Tuner and antenna. 3. Antenna terminals shorted.
		Tuner Phase control.	1. Phase control pulled out to Phase Adjust position.
		Multiplex circuits.	1. Coils L401, L402, and/or L404 open.
2.	Hum with Selector switch in the Mono position only. No signal input.	Power supply.	1. Capacitor C501, C502, C504, C505, or C506 open.
3.	Distortion on strong signal stations. AGC (automatic gain control) circuit not operating properly.	FM tuner or FM circuits of FM circuit board.	1. Faulty FM tuner. 2. Check FM tuner connections to circuit board. 3. Diodes D306 and/or D307 faulty. 4. Capacitor C367 open.
4.	Tune meter not operating properly.	FM circuit on FM circuit board.	1. Transformer T302 slug improperly adjusted (refer to Alignment section of Manual). 2. Faulty meter or meter connections. 3. C362 installed backwards. 4. Meter lug touching pilot lamp socket.
5.	No operation from left FM channel.	Multiplex circuits.	1. Coil L405 or L406 open. 2. Dual diode D427 faulty. 3. Transistor Q406 or Q408 faulty.
6.	No operation from right FM channel.	Multiplex circuits.	1. Coil L407 or L408 open. 2. Dual diode D428 faulty. 3. Transistor Q407 or Q409 faulty.
7.	FM completely dead. Signal and Tune meters inoperative.	FM circuits on FM circuit board.	1. Transistor Q305, Q309, or Q310 faulty. 2. FM tuning unit faulty. 3. Check jumper wires on circuit board.

TEST No.	CONDITION	AREA OF DIFFICULTY	POSSIBLE CAUSE
8.	No FM reception. Signal meter operates but Tune meter does not operate.	FM circuits on FM circuit board.	1. Diode D301 and/or D302 faulty. 2. Transformer T302 faulty. 3. Crystal filter F302 faulty. 4. Transistor Q306 faulty. 5. Integrated circuit IC301 or IC302 faulty.
9.	Signal and Tune meters operative, but no FM reception.	Tuner Squelch control.	1. Squelch control misadjusted. 2. Check connections on Squelch control.
		Multiplex circuits.	1. Coil L401, L402, or L404 open. 2. Diode D421 open. 3. Capacitor C412 or C416 open. 4. Transistor Q403 or Q404 faulty.
10.	Distorted output on FM only.	FM circuits.	1. Diode D301 or D302 faulty. 2. Transformer T302 top slug improperly adjusted. 3. Transistors Q307 or Q308 faulty.
11.	Signal Meter inoperative on FM only.	FM circuits.	1. Diode D303, D304, or D305 faulty. 2. 19 kHz switch in wrong position. Move to Normal.
12.	Signal Meter does not read zero when Tuner is off station.	Signal Meter	1. Mechanical adjustment of meter. Adjust the meter as shown below.
13.	Tune Meter does not read zero (center) when Tuner POWER switch is OFF.	Tune Meter	 1. Remove foam tape. 2. Remove tape over small hole. 3. Adjust lever one way or the other to read O. Use a small screwdriver or similar tool. Be careful not to damage the inside of the meter.

TUNER FM CIRCUITS (Stereophonic)

TEST No.	CONDITION	AREA OF DIFFICULTY	POSSIBLE CAUSE
1.	FM reception normal, FM Stereo indicator does not light, and no stereo reproduction. Lamp is good.	Tuner controls.	1. Selector switch in Mono position. 2. Stereo Threshold control (R499) set too high.
		Multiplex circuits.	1. Check adjustment of coil L409. 2. Transistor Q405, Q410, Q411, Q417, Q418, Q419, or Q420 faulty.
2.	FM reception normal. FM Stereo indicator lights but no stereo reproduction.	Multiplex circuits.	1. Transistor Q405 faulty. 2. Dual diode D429 faulty. 3. Check adjustment of slug in transformer T402. NOTE: Perform steps as shown in Multiplex Adjustments on Pages 62 through 64.
3.	FM Stereo indicator lights on all stations.	Multiplex circuits.	1. Transistor Q419 or Q420 faulty.
4.	Squelch control and Stereo Thresh switch both inoperative. FM reception normal.	Multiplex circuits.	1. Diode D430 or D431 faulty 2. Transistor Q413, Q414 or Q415 faulty.
5.	Squelch control inoperative. Stereo Thresh switch action correct. FM reception normal.	Multiplex circuits.	1. Diode D421 open. 2. Transistor Q401, Q402, or Q412 faulty.
6.	Stereo Thresh switch inoperative. Squelch action correct. FM rection normal.	Multiplex circuits.	1. Transistor Q418, Q419, or Q420 faulty.
7.	Stereo reproduction garbled or distorted.	Multiplex circuits.	1. Transformer T401 incorrectly adjusted. NOTE: Refer to Multiplex Adjustment procedure on Page 62. 2. Capacitor C413 open.



SIGNAL

This meter shows the strength of the received signal.

TUNE

For precise tuning, adjust the Tuning knob so the pointer of the TUNE meter is at the center line between the dark areas of the meter scale.

SELECTOR

This switch is set for the desired FM reception. MONO will allow only FM mono signals from each channel. AUTO will permit the reception of both mono and stereo signals. In the STEREO position, only stereo signals can be received.

TUNING

Is used to perform the tuning. The dial pointer indicates the frequency of the station being received.

PHONE

Each jack can be used for a set of stereo headphones.

FM STEREO

This indicator lamp will glow steadily when an FM stereo signal is received.

POWER

This switch is used to turn the Tuner ON or OFF.

SQUELCH

Adjust this control to eliminate the noise that is heard when tuning between stations. No squelch action is produced when this control is turned fully counterclockwise. Squelch action increases with clockwise rotation and reaches maximum at the full clockwise position.

If this control is turned to maximum (fully clockwise), only the strong stations will be heard. It may be necessary to turn the SQUELCH control off (fully counterclockwise) to receive very weak stations.

PHASE

Adjust this control as follows to obtain maximum separation between the right and left FM stereo channels. Tune in an FM stereo station; then pull out on the control. Adjust the control for minimum output from the speaker systems; then push the control back in. Make this adjustment each time a different FM stereo station is tuned in if you desire maximum channel separation at all times.

BALANCE

Adjusts the left or right channel amplifiers so there is equal sound from the left and right channel speakers. Counterclockwise rotation, from the center (12 o'clock) position, decreases the output from the right channel amplifier; clockwise rotation from the center position decreases the output from the left channel amplifier.

Full counterclockwise rotation of the BALANCE control will produce zero output from the right channel amplifier. Full clockwise rotation will produce zero output from the left channel amplifier.

LEVEL

Simultaneously adjusts the output level at both the VARIABLE and PHONE output connectors.

STEREO THRESH

The setting of the STEREO THRESH (threshold) switch determines the noise level that will switch the Tuner from stereo to monophonic operation when a signal becomes too weak and noisy for good stereo reproduction.

NOISE FILTER

In the ON position, this switch places a noise filter in the circuit that reduces high frequency noise in an FM stereo signal.

FIGURE 3-1

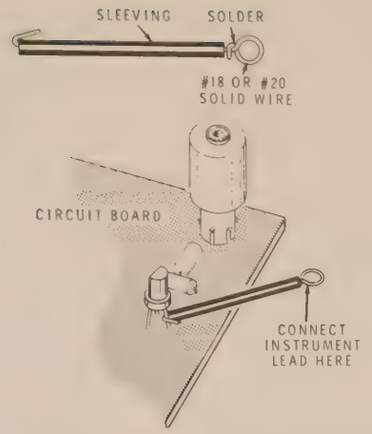


FIGURE 4-7

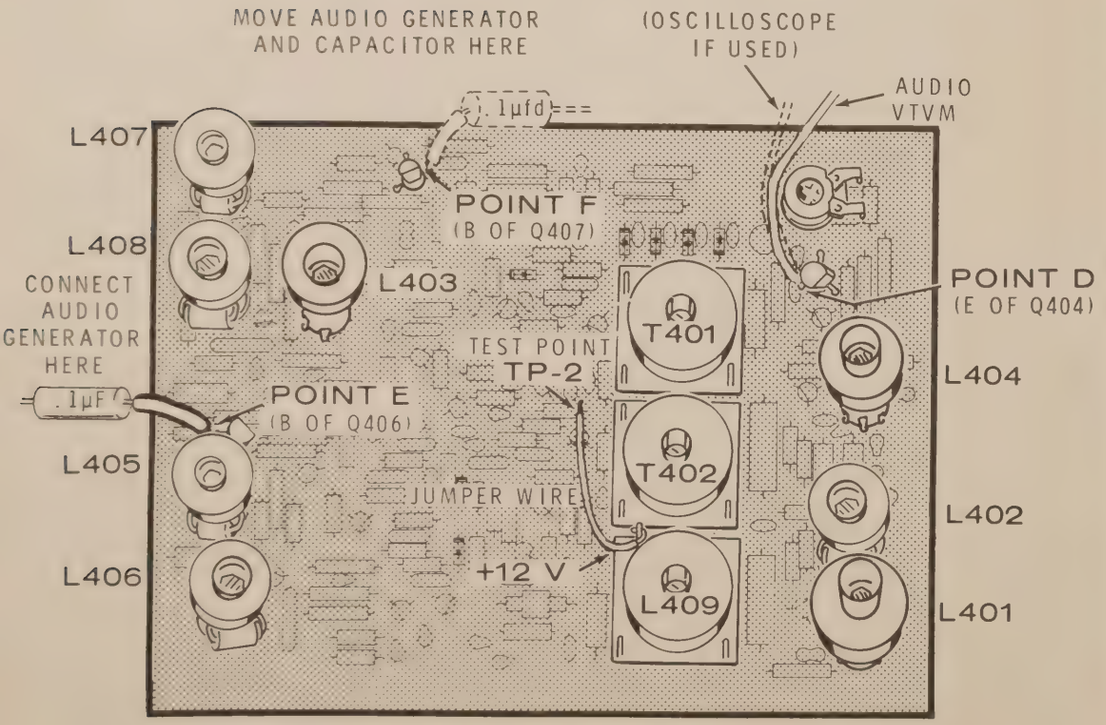


FIGURE 4-8

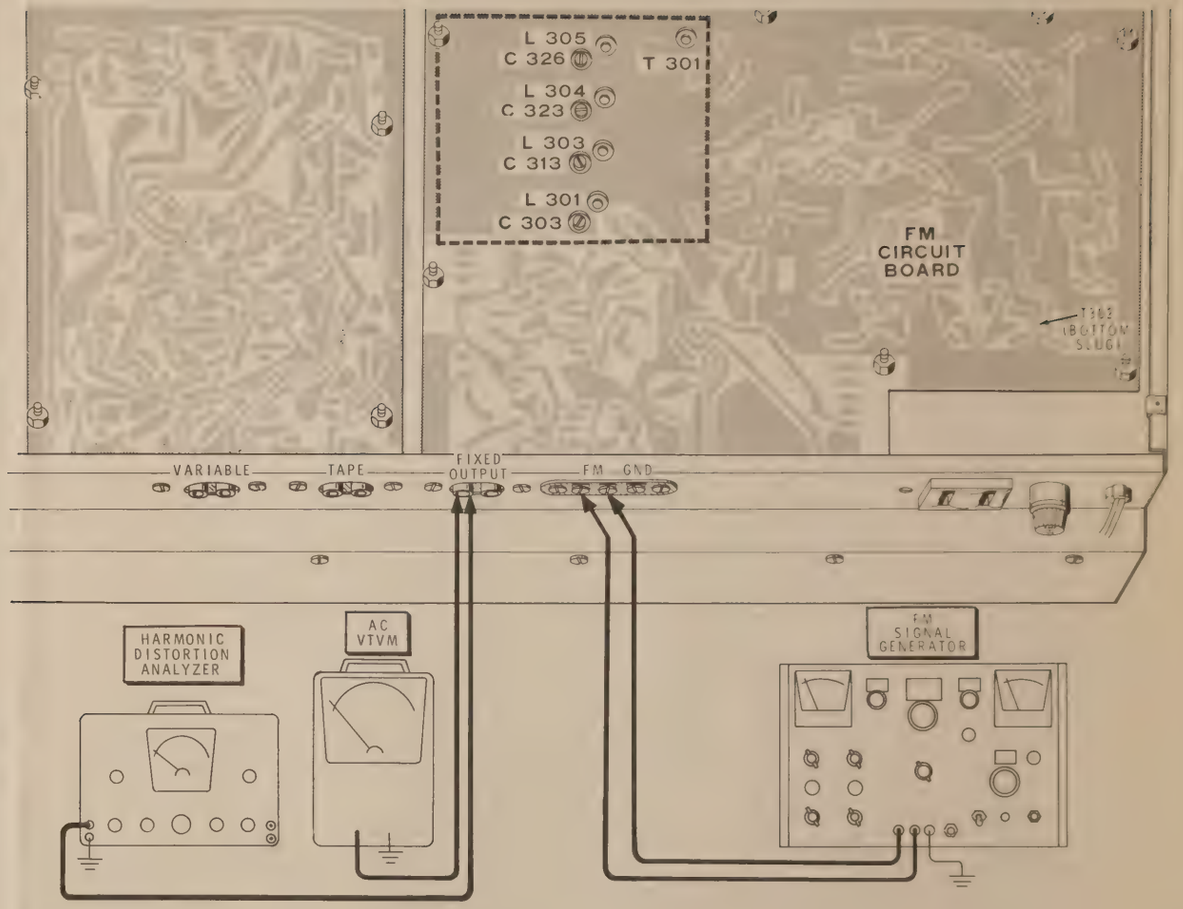


FIGURE 4-1

AUDIO AMPLIFIER SIGNAL INJECTION CHART - TAPE AND FIXED OUTPUTS

TEST No.	TEST INJECTION POINT	NORMAL HUM RESPONSE	POSSIBLE CAUSE IF HUM RESPONSE IS NOT NORMAL
1.	Base (B) of Q104L (Q104R).	Low hum.	1. Transistor Q104L (Q104R) faulty or installed incorrectly. 2. Capacitor C103 (C104) open. 3. Resistors R101 (R102) or R105 (R106) open or changed in value. 4. Tape output only - resistor R107 (R108) open. 4. Fixed output only - resistor R109 (R112) open.
2.	Base (B) of Q408 (Q409).	Low hum or click.	1. Transistor Q408 (Q409) faulty or installed incorrectly. 2. Any component along the signal path (heavy line on Schematic) between Q408 (Q409) and Q104L (Q104R) faulty.
3.	Base (B) of Q406 (Q407).	Medium hum.	1. Transistor Q406 (Q407) faulty or installed incorrectly. 2. Resistors R433 (R448), R434 (R449), R435 (R453), or R437 (R451) changed in value or faulty. 3. Capacitor C428 (C437) faulty.

AUDIO AMPLIFIER SIGNAL INJECTION CHART - VARIABLE AND PHONES OUTPUTS

TEST No.	TEST INJECTION POINT	NORMAL HUM RESPONSE	POSSIBLE CAUSE IF HUM IS NOT NORMAL
1.	Base (B) of Q101L (Q101R)	MEDIUM hum.	1. Transistors Q101L (Q101R), Q102L (Q102R), or Q103L (Q103R) faulty or installed incorrectly. 2. Any of the resistors in these three stages changed in value or faulty. 3. Check the voltages in these three stages, as a problem in any one of these three transistors could cause these circuits to malfunction.

ALIGNMENT

It is recommended that only persons familiar with instrument alignment procedures perform the following adjustments, and then only if the Tuner does not operate properly after the Adjustments have been completed.

PREPARATIONS

Equipment Needed:

FM Signal Generator
Harmonic Distortion Analyzer
11 megohm input AC Voltmeter

Refer to Figure 4-1 (fold-out from Page 82) for the instrument connecting points, and the location of the transformers, coils, and capacitors to be adjusted in the following steps.

Set the Tuner controls as follows:

( ) Selector switch: AUTO position.

( ) SQUELCH control: Fully counterclockwise.

( ) STEREO THRESH switch: MIN.

RATIO DETECTOR (T302)

( ) Connect the FM Signal Generator to the Tuner FM antenna terminals with a 300 Ω lead. Set the Generator frequency to 98 MHz (with no modulation), as shown in part 1 of Figure 4-2, with an unmodulated RF output signal of 100 μV.

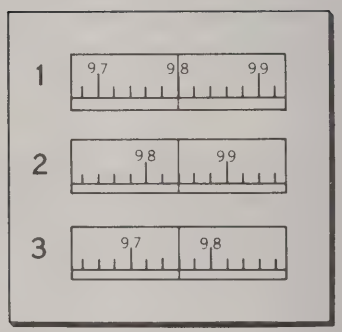


Figure 4-2

( ) Tune the Tuner to this 98 MHz signal. Carefully adjust the Tuning knob until the pointer of the TUNE Meter is at the center mark on the TUNE Meter scale. (See part 1 of Figure 4-3).

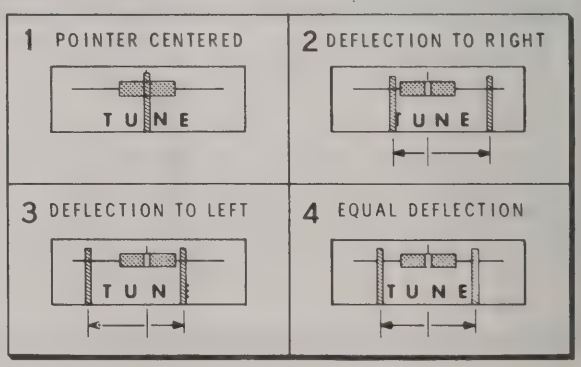


Figure 4-3

The objective of the next two steps is to adjust the secondary of ratio detector transformer T302 so that an equal increase or decrease in frequency, will produce an equal left or right deflection of the pointer of the TUNE Meter. NOTE: The Signal Generator dial readings shown in part 2 and 3 of Figure 4-2, and the TUNE Meter scale readings shown in part 2 and 3 of Figure 4-3 are representative only. The actual Signal Generator dial setting and the actual TUNE Meter readings will probably be different than those shown in these figures.

( ) Increase the frequency of the Signal Generator until the TUNE Meter pointer moves away from the scale center line and then just starts back toward the center line. Note the reading of the Signal Generator frequency dial (see part 2 of Figure 4-2) at this point. Also note the amount that the TUNE Meter pointer deflects away from the center line (see part 2 or 3 of Figure 4-3).

( ) Adjust the FM Signal Generator frequency an equal amount on the other side of the 98 MHz center frequency, and note how far the TUNE Meter pointer deflects on the other side of the center line (see part 4 of Figure 4-3).

( ) Now adjust the bottom slug (the one nearest the circuit board) in ratio detector transformer T302 for an equal left and right deflection of the TUNE Meter pointer when the Signal Generator frequency is alternately changed equal amounts above or below the center frequency of 98 MHz (see parts 2 and 3 of Figure 4-2).

( ) Set the center frequency of the FM Signal Generator to 98 MHz and set the modulation selector switch to 400 Hz. Set the Generator modulation control for a deviation of 75 kHz and set the RF attenuator to produce an output of 1000 μV.

( ) Connect the Harmonic Distortion Analyzer and the AC Voltmeter between the Tuner left or right FIXED jack and ground.

( ) Tune the Tuner to this 98 MHz signal.

( ) Turn the SEP ADJ (separation adjust) control fully clockwise as viewed from the component side of the multiplex circuit board. Then turn the control counterclockwise 1/4 turn. Refer to Figure 4-4.

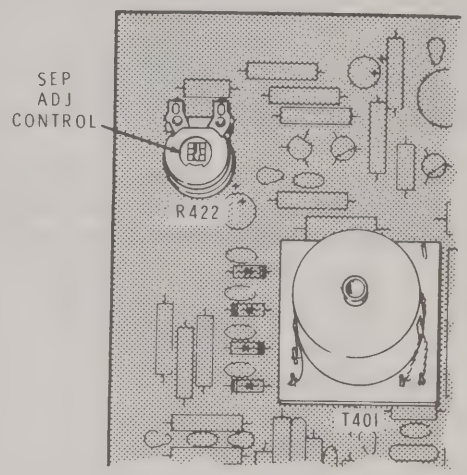


Figure 4-4

( ) If the percent of harmonic distortion exceeds .5 percent, adjust the top slug (this is the one farthest from the circuit board) of ratio detector transformer T302 for minimum distortion.

This completes the alignment of the ratio detector circuit.

MIXER OUTPUT TRANSFORMER

Refer to Figure 4-1 for the following steps.

( ) Connect the Harmonic Distortion Analyzer and the AC Voltmeter between the Tuner left or right FIXED jack and ground.

( ) Set the FM Signal Generator center frequency to 98 MHz and the modulation selector switch to 400 Hz. Set the modulation control for a deviation of 75 kHz.

( ) Connect the FM Signal Generator to the Tuner FM antenna terminals through a 300 Ω resistive matching network as shown in Figure 4-5.

( ) Adjust the output of the Signal Generator to 4 μV (2 μV if a balun match is used).

( ) Carefully tune the Tuner to this 98 MHz signal.

( ) Adjust the top and bottom slugs in transformer T301 for minimum distortion.

NOTE: The Harmonic Distortion Analyzer should indicate 3 percent or less total harmonic distortion. This is equivalent to a 30 dB signal-plus-noise to noise ratio.

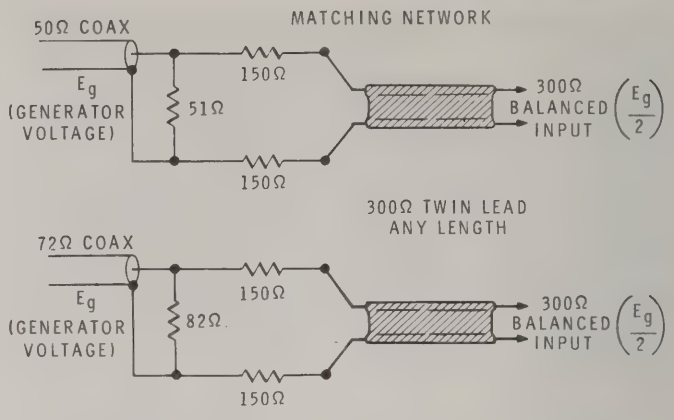


Figure 4-5

FM ALIGNMENT CHART

Step	FM SIGNAL GENERATOR Connect To:	FM SIGNAL GENERATOR Center Frequency and Output	Set Tuner Dial Pointer To:	Connect Harmonic Distortion Analyzer And AC Voltmeter To:	Adjust For: Maximum AC Voltmeter Reading with Minimum Harmonic Distortion.
1.	FM Antenna terminals through 300 Ω matching network.	90 MHz at 4 μV. (See NOTE).	90 MHz	Left or right FIXED jack.	1. L305 (very sharp). 2. L304. 3. L303. 4. L301 (very broad).
2.	Same as Step 1.	106 MHz at 4 μV (see (NOTE).	106 MHz	Same as above for Step 1.	1. C326 (very sharp). 2. C323. 3. C313. 4. C303 (very broad).
3.	Repeat Steps 1 and 2 until no further improvement can be obtained.				
NOTE: Increase output as necessary for initial readings; then reduce output to 4 μV (2 μV if balun match is used).					

Disconnect the Signal Generator, Harmonic Distortion Analyzer, AC Voltmeter and the antenna matching network from the Tuner.

MULTIPLEX CIRCUITS

An Audio Generator and an 11 megohm input Audio Voltmeter are required to align the multiplex circuits. An FM Stereo Generator may also be used if one is available.

NOTE: An oscilloscope may be used as a monitoring device if desired. No waveforms are shown in the Manual, however, as the oscilloscope will only show if the waveform being observed should distort due to excessive input signal voltage from the alignment generators.

Preset the Tuner controls and switches as follows:

Selector: AUTO.

LEVEL: Fully counterclockwise.

PHASE: Pushed in and turned to center of rotation.

SQUELCH: Full counterclockwise.

STEREO THRESH: MIN position.

NOISE FILTER: OFF.

Refer to Figure 4-6 for the next two steps.

NOTE: Make sure the following connections are made only to the point specified in the step, and that the leads do not short circuit to other connections on the circuit board.

( ) Use insulated hookup wire and connect a short jumper between Point A (S-1) and Point B (S-1) on the foil side of the FM circuit board.

( ) Place a short length of sleeving over the positive (+) lead of a 10 µF 25 V electrolytic capacitor. Then connect this lead to point C on the foil side of the FM circuit board.

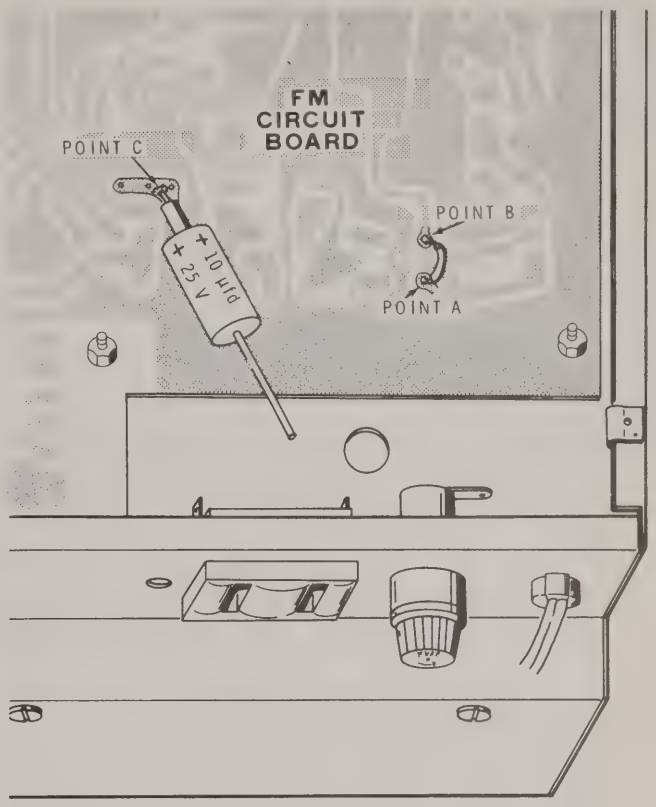


Figure 4-6

( ) Connect the Audio Generator between the free lead of the 10 µF capacitor and ground. Set the Generator frequency to 67 kHz (±500 Hz) with an output of .1 volt rms.

NOTE: Special connector clips are available from any radio-TV parts supply house for making connections to parts mounted on circuit boards. However, simple hook-type connectors may be constructed using a short length of solid (approximately #18) hookup wire covered with insulating sleeving as shown in Figure 4-7. Connect the test instrument leads between the free end of the connector and chassis ground.

Refer to Figures 4-7 and 4-8 (fold-out from Page 82) for the following steps.

( ) Connect the Audio Voltmeter (and the Oscilloscope if used) to Point D (emitter of Q404).

( ) Turn the slug in coil L401 counterclockwise until a peak reading is obtained on the Audio Voltmeter.

( ) Adjust the slug in coil L404 for a minimum reading on the Audio Voltmeter.

( ) Readjust the slug in coil L401 for a minimum reading on the Audio Voltmeter. This minimum reading should be 3 millivolts or less.

( ) Set the Audio Generator frequency to 57 kHz (±500 Hz) with an output of .1 volt rms.

( ) Adjust the slug in coil L402 for a maximum Voltmeter reading.

( ) Disconnect the Audio Generator from the 10 μF capacitor at Point C on the FM circuit board. Do not disconnect the 10 μF capacitor.

( ) Connect the Audio Voltmeter (and the Oscilloscope if used) to the left FIXED jack of the Tuner.

( ) Place a length of sleeving on one lead of a .1 μF capacitor. Then bend the exposed wire back over the sleeving to provide a hook similar to that shown in Figure 4-7.

( ) Connect the Audio Generator through this .1 μF capacitor to Point E (base of Q406) on the multiplex circuit board, as shown in Figure 4-8.

( ) Set the Generator frequency to 19 kHz (±100 Hz) with an output of 1 volt.

( ) Adjust the slug in coil L405 for a minimum reading on the Voltmeter.

( ) Set the Generator to 36 kHz (±200 Hz) with 1 volt rms output.

( ) Adjust the slug in coil L406 for a minimum reading on the Voltmeter.

( ) Disconnect both the Audio Generator and the .1 μF capacitor from Point E.

( ) Connect the .1 μF capacitor to Point F (base of Q407) on the multiplex circuit board, as shown in Figure 4-8.

( ) Connect the audio wattmeter (and oscilloscope when used) to the right FIXED jack of the Tuner.

( ) Connect the Audio Generator through this .1 μF capacitor to Point F (base of Q407) on the multiplex circuit board, as shown in Figure 4-8.

( ) Set the Generator frequency to 19 kHz (±100 Hz) with an output of 1 volt rms.

( ) Adjust the slug in coil L407 for a minimum reading on the Voltmeter.

( ) Set the Generator frequency to 36 kHz (±200 Hz) with an output of 1 volt rms.

( ) Adjust the slug in coil L408 for a minimum reading on the Voltmeter.

( ) Disconnect both the Generator and the .1 μF capacitor from Point F on the multiplex circuit board.

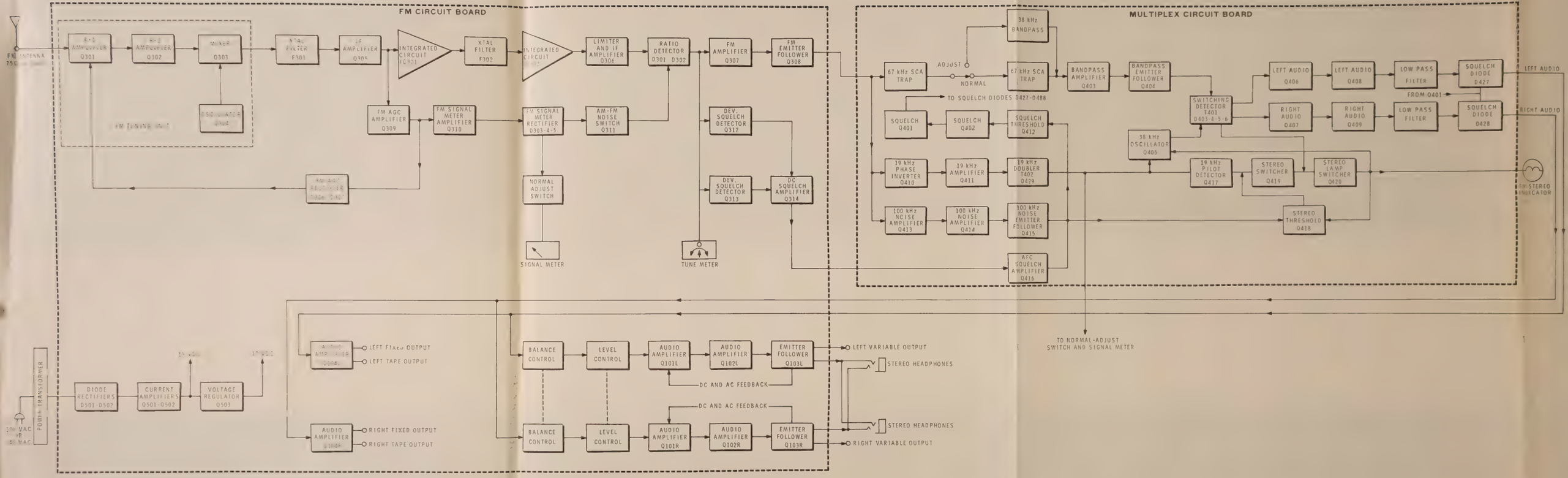
( ) Disconnect the jumper wire and 10 μF capacitor from the foil side of the FM circuit board.

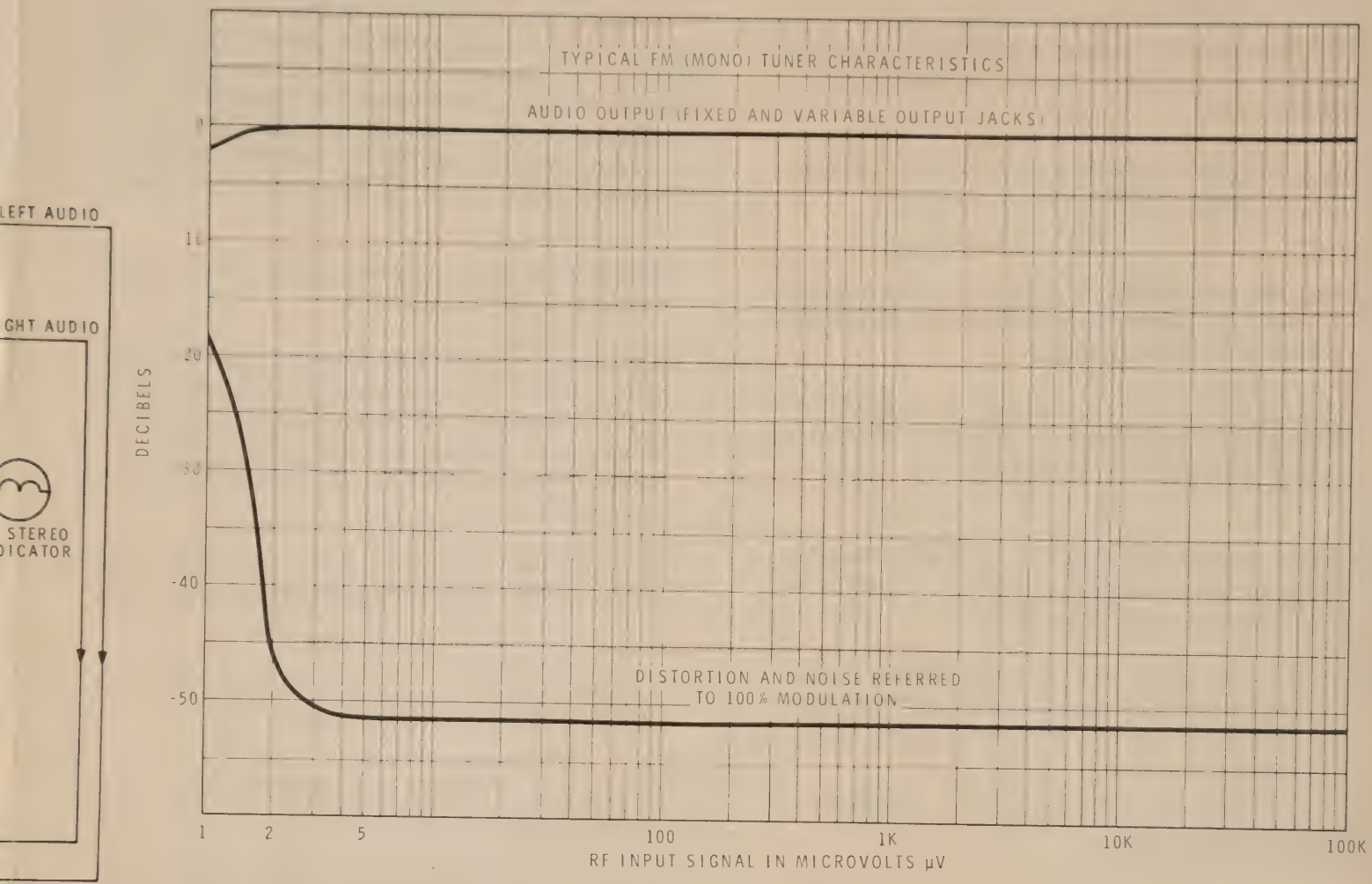
STEREO ADJUSTMENT

These adjustments should be made only if you want to measure the channel separation of the Tuner or make a more accurate adjustment of the separation control, R422: If you do not desire to make this measurement and adjustment, disregard the following steps and disconnect the Alignment Equipment. Then turn to Page 62 and complete the steps under Multiplex Adjustments.

Refer to Figures 4-7 and 4-8 for the following steps.

( ) Place the NORMAL-ADJUST switch, which is on the FM circuit board, in the ADJUST position.


FM CIRCUIT BOARD
MULTIPLEX CIRCUIT BOARD
FM ANTENNA 75Ω
R-F AMPLIFIER Q301
R-F AMPLIFIER Q302
MIXER Q303
OSCILLATOR Q304
XTAL FILTER F301
I-F AMPLIFIER Q305
INTEGRATED CIRCUIT IC301
XTAL FILTER F302
INTEGRATED CIRCUIT IC302
LIMITER AND I-F AMPLIFIER Q306
RATIO DETECTOR D301 D302
FM AMPLIFIER Q307
FM EMITTER FOLLOWER Q308
FM AGC AMPLIFIER Q309
FM SIGNAL METER AMPLIFIER Q310
FM SIGNAL METER RECTIFIER D303-4-5
AM-FM NOISE SWITCH Q311
DEV. SQUELCH DETECTOR Q312
DEV. SQUELCH DETECTOR Q313
DC SQUELCH AMPLIFIER Q314
NORMAL ADJUST SWITCH
SIGNAL METER
TUNE METER
38 kHz BANDPASS
67 kHz SCA TRAP
ADJUST
NORMAL
67 kHz SCA TRAP
BANDPASS AMPLIFIER Q403
BANDPASS EMITTER FOLLOWER Q404
TO SQUELCH DIODES D427-D428
SQUELCH Q401
SQUELCH Q402
SQUELCH THRESHOLD Q412
SWITCHING DETECTOR T401 D403-4-5-6
LEFT AUDIO Q406
LEFT AUDIO Q408
LOW PASS FILTER
SQUELCH DIODE D427
LEFT AUDIO
FROM Q401
RIGHT AUDIO Q407
RIGHT AUDIO Q409
LOW PASS FILTER
SQUELCH DIODE D428
RIGHT AUDIO
38 kHz OSCILLATOR Q405
19 kHz PHASE INVERTER Q410
19 kHz AMPLIFIER Q411
19 kHz DOUBLER T402 D429
19 kHz PILOT DETECTOR Q417
STEREO SWITCHER Q419
STEREO LAMP SWITCHER Q420
FM STEREO INDICATOR
100 kHz NOISE AMPLIFIER Q413
100 kHz NOISE AMPLIFIER Q414
100 kHz NOISE EMITTER FOLLOWER Q415
STEREO THRESHOLD Q418
AFC SQUELCH AMPLIFIER Q416
TO NORMAL-ADJUST SWITCH AND SIGNAL METER
POWER TRANSFORMER
DIODE RECTIFIERS D501-D502
CURRENT AMPLIFIERS Q501-Q502
VOLTAGE REGULATOR Q503
AUDIO AMPLIFIER Q504
LEFT FIXED OUTPUT
LEFT TAPE OUTPUT
AUDIO AMPLIFIER Q505
RIGHT FIXED OUTPUT
RIGHT TAPE OUTPUT
BALANCE CONTROL
LEVEL CONTROL
AUDIO AMPLIFIER Q101L
AUDIO AMPLIFIER Q102L
EMITTER FOLLOWER Q103L
DC AND AC FEEDBACK
LEFT VARIABLE OUTPUT
STEREO HEADPHONES
BALANCE CONTROL
LEVEL CONTROL
AUDIO AMPLIFIER Q101R
AUDIO AMPLIFIER Q102R
EMITTER FOLLOWER Q103R
DC AND AC FEEDBACK
STEREO HEADPHONES
RIGHT VARIABLE OUTPUT


TYPICAL FM (MONO) TUNER CHARACTERISTICS
AUDIO OUTPUT (FIXED AND VARIABLE OUTPUT JACKS)
DECIBELS
0
-10
-20
-30
-40
-50
DISTORTION AND NOISE REFERRED TO 100% MODULATION
1
2
5
100
1K
10K
100K
RF INPUT SIGNAL IN MICROVOLTS μV

LEFT AUDIO
GHT AUDIO
STEREO
DICATOR

SPECIFICATIONS

TUNER SECTION

Tuning Range	88 to 108 MHz.
Intermediate Frequency (IF)	10.7 MHz.
Frequency Response	±1 dB, 20 to 15 kHz.
Antenna	75 Ω unbalanced or 300 Ω balanced external antennas.
Sensitivity	1.8 μV.*
Volume Sensitivity	Below measurable level.
Selectivity	70 dB.*
Image Rejection	90 dB.*
IF Rejection	90 dB.*
Capture Ratio	1.5 dB.*
AM Suppression	50 dB.*
Harmonic Distortion	0.5% or less.*
Intermodulation	0.5% or less.*
Hum and Noise	65 dB.*
Spurious Rejection	100 dB.*

*Rated IHF (Institute of High Fidelity) Standards.

STEREOPHONIC SECTION

Channel Separation	40 dB or greater at midfrequencies. 30 dB at 50 Hz. 25 dB at 10 kHz. 20 dB at 15 kHz.
Frequency Response	±1 dB from 20 to 15 kHz.
Harmonic Distortion	1% at 1000 Hz with 100% modulation.
19 kHz and 38 kHz Suppression	55 dB or greater.
SCA Suppression	50 dB.

AUDIO SECTION

Output Voltage:	
Tape and Fixed	1.5 Volts rms nominal (with 100% modulation).
Phone and Variable	0 to 4 Volts rms before clipping (with 100% modulation).
Output Impedance:	
Tape and Fixed	Approximately 9000 Ω.
Phone and Variable	100 Ω.

GENERAL

AC Outlet Socket	Unswitched; 350 watts maximum.
Power Requirements	105-125 or 210-250 volts 50/60 Hz AC 0.25 watts.
Dimensions	Overall: 16-7/8" wide x 4-3/4" high x 12-1/2" deep.
Mounting	AE-18 accessory cabinet or custom mounting.
Net Weight	11-1/2 lbs.

The Heath Company reserves the right to discontinue products and to change specifications at any time without incurring any obligation to incorporate new features in products previously sold.

CIRCUIT DESCRIPTION

Refer to the Schematic Diagram (fold-out from Page 115), and the Block Diagram (fold-out from Page 90), while you read this Circuit Description.

To help you locate specific parts in the Tuner, or on the Schematic Diagram, the circuit part numbers (R101, C305, L406, Q402, etc.) for resistors, capacitors, coils, and transistors, are in the following groups:

100-199 Parts in the Audio Circuit.
300-399 Parts in the FM Tuner Circuit.
400-499 Parts in the Multiplex Circuit.
500-599 Parts in the Power Supply Circuit.

Each of the circuits listed above will be described separately.

FM TUNER CIRCUITS

The FM tuner circuit board consists of a pre-assembled FM tuning unit and an IF amplifier and detector section. The tuning unit and the IF and detector sections will be described separately.

FM TUNING UNIT

The FM tuning unit receives FM broadcast signals between 88 MHz and 108 MHz, and converts them to an IF frequency of 10.7 MHz. This tuning unit contains two RF amplifier stages, a mixer stage, and an oscillator stage.

Field effect transistors (F.E.T.) are used in the RF and mixer stages of the tuning unit. They contain elements that are called "source," "gate," and "drain." See Figure 5-1. These elements compare with the emitter, base, and collector in other transistors. Either the source (emitter) or the gate (base) will control the drain (collector) current to amplify a signal.

Field effect transistors offer the advantages of greater linearity, low cross-modulation, and the ability to amplify larger signals without distortion. These features provide superior operation of the RF and Mixer stages of the FM tuner.

FM station signals are coupled from an external 75 ohm or 300 ohm FM antenna to the primary winding of antenna coil L301. The secondary winding of L301 is in a tuned circuit that consists of capacitors C301 and C303, and the antenna

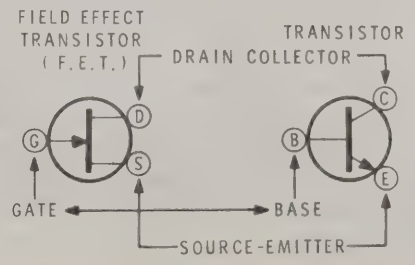


Figure 5-1

section of the variable tuning capacitor (C302A). C302A tunes the circuit to the frequency of the desired station. Capacitor C304 couples the tuned signal to the gate (G) of first RF amplifier F.E.T. Q301. Resistor R301 couples AGC (automatic gain control) voltage to the gate of Q301. The AGC circuit will be described later.

F.E.T.'s Q301 and Q302 form a cascode RF amplifier. Coil L302 and capacitor C308 couple the signal from the drain (D) of Q301 to the source (S) of Q302. A third winding on L302 couples a portion of the signal back to the gate of Q301; through C306. This improves the stability and gain of the stage.

The amplified signal at the drain of Q302 is tuned by the circuit made up of L303, C313, C315, and the RF section of the variable tuning capacitor (C302B). This signal is coupled through C318 to another tuned RF circuit, and to the gate of mixer F.E.T. Q303. Section C of variable tuning capacitor C302, along with C321, C323, and coil L304, make up this tuned RF circuit.

Transistor Q304 operates as a grounded-base oscillator. The frequency of oscillation is determined by the primary winding of L305, capacitors C326, C327, and the oscillator section of the variable tuning capacitor (C302D). The secondary winding of L305 couples the oscillator signal to the source of mixer F.E.T. Q303. The oscillator operates at 10.7 MHz higher than the received signal.

Mixer F.E.T. Q303 combines the incoming tuned RF signal that is applied to its gate with the oscillator signal that is applied to its source. The mixing of these two signals in Q303 produces an IF signal (10.7 MHz) equal to the difference between the RF and oscillator signal frequencies.

The IF signal from the drain of the mixer F.E.T. is selected by transformer T301. Both the primary and the secondary of T301 are tuned to the IF frequency. The IF signal is then coupled through capacitor C332 and resistor R312 to the IF amplifier stages.

FM IF

The amplification, bandpass, and limiting characteristics, that are required in the FM IF section, are provided by two crystal filters, two integrated circuits, and two conventional transistor amplifier stages.

The specially-designed quartz crystal filters (F301 and F302) replace conventional IF tuned circuits, and eliminate the need for IF alignment, except for the detector coil. These crystal filters provide a steep-skirted, flat-topped bandpass with very linear phase characteristics at all signal levels.

The integrated circuits, IC301 and IC302, are compact miniature amplifiers, each containing ten transistors, seven diodes, and eleven resistors. See the integrated circuit Schematic that is printed as an inset on the main Schematic Diagram. The signal path through the integrated circuit is shown by heavy lines. The signal input at pin 1 couples to the base of transistor A. Transistors B, E, and H are amplifiers, while A, C, D, F, and G are emitter followers used for signal coupling. Transistors J and K, and diodes D1 and D2, form a voltage regulating circuit. The amplified signal from the collector of grounded-base transistor H is taken from pin 5 of the integrated circuit.

From the FM tuning unit, the IF signal is coupled through resistor R312, crystal filter F301, and capacitor C337 to the base of transistor Q305. Part of the amplified signal from the collector of Q305 is coupled through C342 to AGC and meter amplifier transistors Q309 and Q310.

The IF signal from the collector of transistor Q305 is also coupled through capacitor C343 to the input of integrated circuit IC301. Both amplification and limiting (clipping) takes place in the integrated circuit. Limiting removes any noise pulses or amplitude modulation (AM) that may be superimposed on the FM signal. From IC301, the signal is coupled directly to crystal filter F302 where greater selectivity is obtained. The signal is then coupled through C347 to IC302 for further amplification and limiting. The signal output of IC302 is coupled through C352 to the base of transistor Q306, the final IF amplifier and limiter.

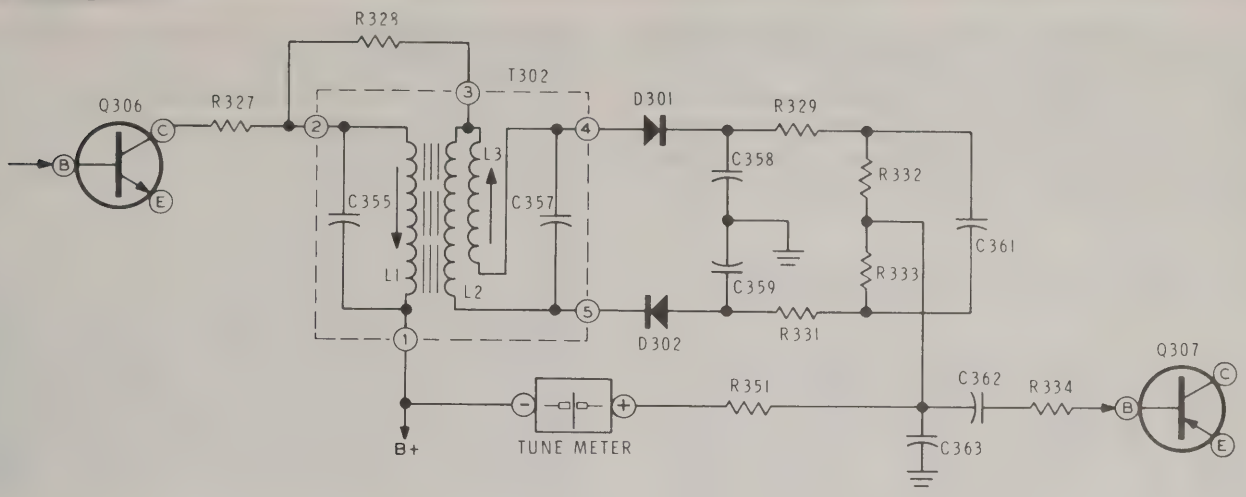


Figure 5-2

RATIO DETECTOR

From the collector of transistor Q306, the IF signal is coupled through resistor R327 to transformer T302 in the ratio detector circuit. See Figure 5-2. Transformer T302 has a primary winding, L1, that is tuned to 10.7 MHz, and two bifilar-wound secondary windings, L2 and L3. Resistor R328 provides a DC path between the primary of T302 and the start of the two secondary windings.

A separate voltage is induced by the primary into each of the two secondary windings. The amplitude of these voltages stays relatively constant due to the limiting action of transistor Q306 (and the previous integrated circuits).

The two induced voltages, at L2 and L3, cause two separate current loops to operate in the ratio detector circuit. The current in one loop flows through L3; diode D301; resistors R329, R332, and R351; the Tune Meter; L1; and through resistor R328 to the other side of winding L3. The current in the other loop flows through L2; diode D302; resistors R331, R333, and R351; the Tune Meter; L1; and through resistor R328 to the other side of winding L2. The two currents that flow in this circuit are DC, since they are rectified by diodes D301 and D302. Note that both of these DC currents flow through resistor R351, the Tune Meter, the primary of T302, and resistor R328. At the FM IF center frequency of 10.7 MHz, the two currents are of equal amplitude; therefore, they cancel each other and no current flows.

When the IF frequency deviates from 10.7 MHz due to FM modulation (audio signal), the current in one loop increases while the current in the other loop decreases; these current changes are due to the change in phase relationship in the signal currents across coils L1, L2, and L3.

Now, a current that is controlled by the FM modulation flows through resistor R351 and the Tune Meter; this current causes the audio output signal to be developed across resistor R351 and the Tune Meter. The audio output signal is taken from the ratio detector circuit at the junction of resistors R332 and R333. It is then coupled through capacitor C362 and resistor R334 to audio amplifier transistor Q307.

The amplitude of the output signal is determined by how far the IF frequency deviates above and below 10.7 MHz. The frequency of this audio output signal is determined by how often the frequency deviates above and below 10.7 MHz.

When the Tuner is correctly tuned to the FM station, an IF center frequency of 10.7 MHz is produced, no steady current flows in the ratio detector circuit, and the pointer of the Tune Meter remains at rest. When the Tuner is tuned away from the center frequency of the FM station, an IF center frequency is produced that is either higher or lower than 10.7 MHz. This frequency causes one of the diode loops to conduct more than the other. The resulting unbalance in currents through the Tune Meter causes its pointer to indicate the direction (high or low) in which the Tuner is being detuned.

Transistor Q307 amplifies the audio signal and direct-couples it to the base of emitter-follower transistor Q308. Q308 couples the low impedance signal to the multiplex circuit. Resistor R338 provides negative feedback that maintains stability and low distortion in the audio circuit.

AGC AND METER AMPLIFIER CIRCUITS

A portion of the IF signal is taken from input IF amplifier Q305, through capacitor C342; and amplified by transistor Q309. The amplified signal is then coupled from the collector of Q309, through C367, to voltage-doubler rectifier diodes D306 and D307. After being rectified and doubled this voltage is filtered by C366, R342, and C365, and becomes the AGC voltage for controlling F.E.T. Q301.

The AGC voltage is proportional to the strength of the received FM station signal, and is applied to the gate of RF amplifier Q301 through resistor R301. As stronger FM station signals (200 μV or more) are received, the increased AGC voltage applied to the gate of Q301 reduces its amplification. This prevents overloading and distortion when strong signals are received.

The signal from the collector of Q309 also is direct-coupled to the base of meter amplifier transistor Q310. The amplified signal from the collector of Q310 is coupled through capacitor C368 to voltage-doubler rectifier diodes D303 and D304. The voltage across diode D305 with resistor R348 in series is proportional to the signal strength, and the Signal Meter deflects accordingly. Diode D305 acts as a voltage compressor and meter protector.

AF SQUELCH CONTROL CIRCUIT

A special circuit is used in this Tuner to eliminate the harsh distortion that occurs when you tune to the edge of an FM station. This deviation detector circuit, which is comprised of transistors Q312, Q313, and Q314, controls the squelch circuits in the multiplex section.

The positive or negative voltage that appears at the junction of resistors R332 and R333 is coupled through R352 to the bases of transistors Q312 and Q313. These transistors are biased by resistors R354 and R355 so a small voltage change at the ratio detector output will cause one or the other transistor to conduct. The collector of Q312 is direct coupled to the base of Q314, while the collector of Q313 is direct coupled to the collector of Q314. Thus, either a positive or a negative voltage from the ratio detector (caused by tuning either side of the center frequency) will cause a positive voltage to appear at the collector of transistor Q314. This positive voltage is applied to transistor Q416 on the multiplex circuit board where it actuates the squelch and stereo threshold circuits, as will be described later.

MULTIPLEX CIRCUITS

Figures 5-3A and 5-3B show two sample signals that might appear at the left (L) and right (R) channel microphones at a radio station that is broadcasting FM stereo. The transmitting circuits then combine these signals to produce the L+R (main channel) signal shown in Figures 5-4A and the L-R (subchannel) signal shown in Figure 5-4B. Note that the L-R signal is superimposed on a 38 kHz signal as shown in Figure 5-4C. The L-R subcarrier signal is a suppressed-carrier amplitude-modulated signal on a 38 kHz subcarrier, and is called the subcarrier channel.

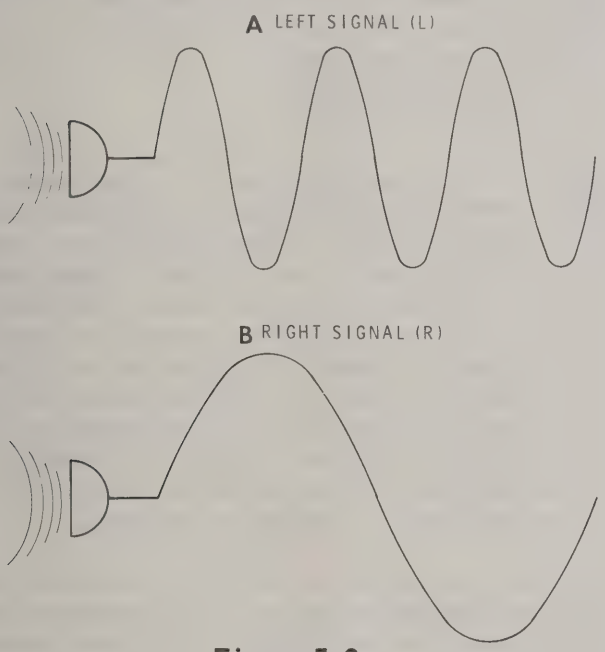


Figure 5-3

The L+R (main channel) signal and the L-R (subcarrier) signal, are combined with the 19 kHz pilot signal shown in Figure 5-4D, and the entire complex signal frequency modulates the transmitted RF carrier.

A second subcarrier signal is transmitted by some stations at a frequency of 67 kHz. This channel, which is modulated by a commercial music signal, is called the SCA (Subsidiary Communications Authorization) channel.

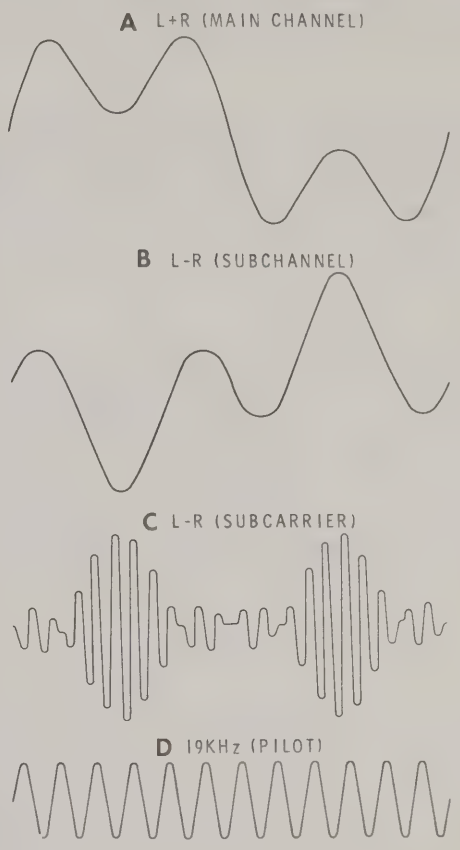


Figure 5-4

Figure 5-5 shows where the different components are to be found in a stereo FM signal. The L+R signal, which is in the audio spectrum (50 Hz to 15 kHz), is called the "main channel." Monophonic FM receivers use only this part of the signal, and the remaining signal components are attenuated by the de-emphasis network.

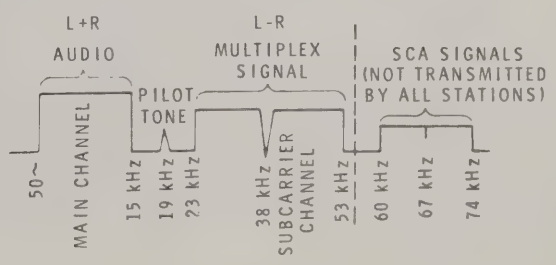


Figure 5-5

Refer to the Multiplex Block Diagram (Figure 5-6, fold-out from Page 99) and to the Schematic Diagram (fold-out from Page 115) while you read the following description of the multiplex circuits.

The composite stereo signal from the output of the FM Tuner circuit is applied to three separate multiplex input circuits: to the SCA and 38 kHz filter circuits, to the 19 kHz phase inverter (Q410) and amplifier (Q411), and to the 100 kHz noise amplifier circuit (Q413, Q414, and Q415).

The three signal paths are shown on the Multiplex Block Diagram, with the program part of the composite stereo signal across the top. The 19 kHz pilot signal, and the 100 kHz noise signal, that control the program part of the composite stereo signal and eliminate the noise, are shown across the bottom of the Block Diagram. Each of these signal paths, and their circuits, will be described separately on the following pages.

STEREO PROGRAM SIGNALS

When a stereo program is received, the (L+R)+(L-R) program part of the stereo signal is passed through several filter circuits which remove unwanted signals. The first of these filter circuits is a 67 kHz parallel SCA trap, composed of coil L401 and capacitor C403. L402 filters out noise components above 53 kHz to prevent them from beating with harmonics of the 38 kHz oscillator and subcarrier.

Another 67 kHz parallel trap is composed of L404 and C408. This trap eliminates any remaining 67 kHz SCA subcarrier, and also acts as a 38 kHz bandpass filter when the Phase switch is in the Adjust position (Phase control shaft pulled out). In the Adjust position, the Phase switch removes C409 from the circuit and inserts C405 in series with L402 to form a 38 kHz series resonant circuit. This circuit is adjusted so it will pass only the subcarrier and shift the subcarrier 90 degrees with respect to the 19 kHz pilot signal. The 90 degree phase shift causes a null to be obtained when the Phase control is properly adjusted.

The output of the filter networks is coupled through capacitor C412 to transistor Q403. The amplified signal is then direct coupled to the base of emitter-follower transistor Q404. Bias and stability for Q403 is provided by feedback resistor R417.

Separation control R422 is used to adjust the amount of composite stereo signal that is coupled through capacitor C416 to transformer T401. The ratio between the amount of composite signal and the amount of compensating signal that is fed to the switching detector output through R429 and R431, determines the amount of separation between the right and left audio signals. The compensating signal will be described in the following paragraphs along with the Switching Detector.

SWITCHING DETECTOR

Figure 5-7 shows the various waveforms present in the switching detector circuit. Waveform 1 is the composite main channel (L+R) and subchannel (L-R) stereo signal that comes from transistor Q404. Waveform 2 is a 38 kHz oscillator signal from Q405. This signal was locked to the same frequency and phase as the 38 kHz subcarrier by a pulsating DC from diode D429. Waveform 3 results from adding stereo signal 1 to the 38 kHz oscillator signal 2. Waveform 3 is then applied to the switching diodes from the secondary winding of transformer T401.

Detection occurs in the switching diodes in the following manner. Waveform 3 from transformer T401 passes through two circuits. One circuit consists of the secondary winding of transformer T401 and diodes D423 and D426. Since these diodes pass only the positive peaks of waveform 3, only the left signal (waveform 4) is passed to transistor Q406. The other circuit consists of the secondary winding of T401 and diodes D424 and D425. These diodes pass only the negative peaks of waveform 3 and couple the right signal waveform to transistor Q407. Capacitors C421, C422, C423, and C424 charge to the positive and negative peaks of waveform 3 to produce smooth output waveforms 4 and 5.

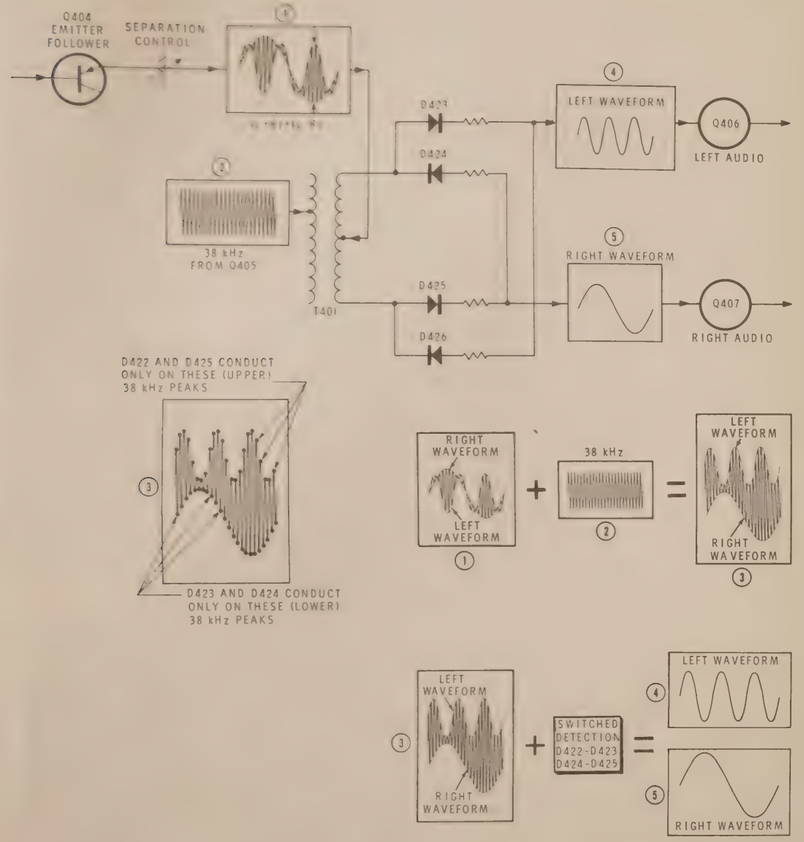
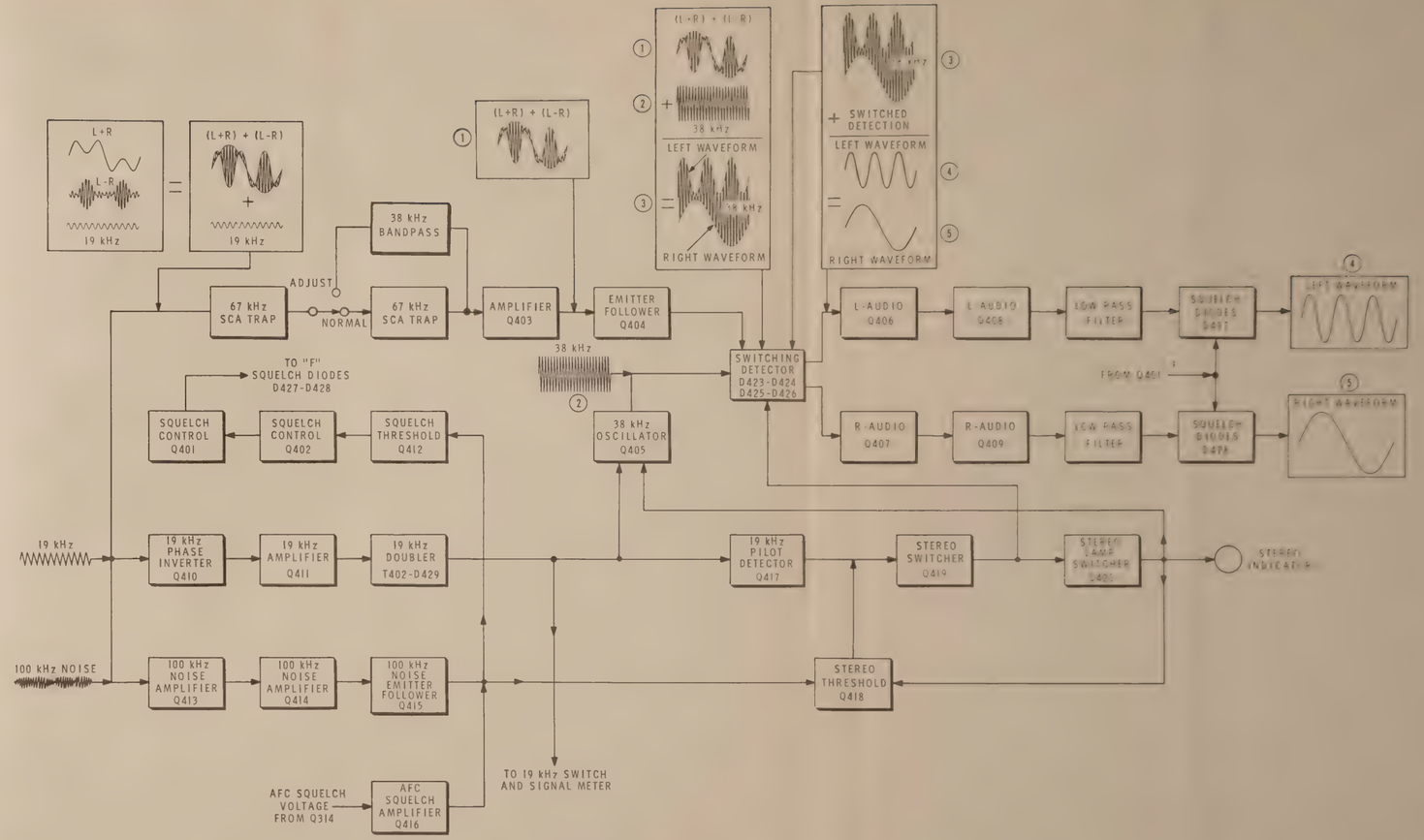


Figure 5-7



MULTIPLEX CIRCUIT BLOCK DIAGRAM
FIGURE 5-6

Since the detection process is not 100 percent efficient, some right channel signal may be present at the left channel output and vice versa. To compensate for this, a portion of the composite stereo signal is taken from the multiplex input and fed to the left and right channel circuits. The composite stereo signal passes through a frequency selective network composed of resistor R408, coil L403, and capacitors C407 and C411, and through resistors R429 and R431 to the outputs of the left and right detector diodes. This compensating signal is 180 degrees out-of-phase with the outputs of the diodes, and it cancels each channel's signal in the other channel. In this way, greater channel separation is obtained, even at higher audio frequencies.

The Noise Filter switch, in the On position, connects capacitor C425 between the outputs of the left and right detectors. The capacitor couples together the higher audio frequencies of each channel. Since the subchannel and noise signals are 180 degrees out-of-phase at these points, the noise frequency is cancelled.

AUDIO SIGNALS

The left channel signal is coupled through a de-emphasis network composed of resistor R432 and capacitor C426, and through C427 to transistor Q406. De-emphasis is required in the audio stages to reduce high frequency signals that were pre-emphasized at the transmitter. This provides a flat audio frequency response. The right channel signal is coupled through a similar network to transistor Q407. Since the left and right channel circuits are identical from this point on, only the left channel circuits will be described.

Transistors Q406 and Q408 are direct coupled and amplify the detected audio signal. Resistor R436 provides DC feedback to the emitter of Q406 for additional stability, while resistor R438 couples the audio signal to a 19 kHz trap circuit and a 15 kHz low-pass filter. The trap circuit consists of coil L405 and capacitor C429. The low-pass filter consists of L406, C431, C432, and C433. These circuits pass audio frequencies below 15 kHz and filter out any 19 kHz pilot signals and subcarrier frequencies from 23 kHz to 53 kHz.

The left channel audio signal from the trap and filter is fed to the squelch dual diode, D427. This diode is biased by three separate DC voltages so it will conduct when the Squelch control setting and signal and noise conditions are proper. One diode bias source is from the collector of Q408, through R438, L405, and L406. Another bias voltage is obtained through R444 from the 12 volt source. The third bias voltage is obtained through R443 from the collector of squelch control transistor Q401. The actual purpose and function of these diode biasing voltages will be described later. For now we must assume that proper conditions are met and the dual diode is properly biased to conduct the audio signal.

The audio output of dual diode D427 is coupled through capacitor C434 and resistor R445 to Balance control R111, and through capacitor C101 to the base of audio preamplifier Q104L. The audio stages will be explained later.

We have traced a composite stereo program signal through the multiplex circuit, with the assumption that the 19 kHz pilot signal had performed its various functions. We also assumed that no 100 kHz noise signal or AFC squelch voltage has triggered the multiplex circuits to block the passage of the composite stereo program signal. The following is a description of the circuits that are activated by the 19 kHz pilot signal.

19 kHz PILOT SIGNAL

The 19 kHz pilot signal that is received from the FM tuner circuit, is coupled through capacitor C444 to the parallel resonant circuit of L409 and C445. This tuned circuit passes the 19 kHz pilot signal and rejects all other frequencies. The pilot signal is coupled through C446 to the base of transistor Q410, which acts as a phase inverter. 19 kHz signals appear at the emitter and collector of Q410, 180 degrees out-of-phase with each other. Phase control R497 and capacitor C448 are connected across the output of Q410 so the phase of the 19 kHz output signal can be adjusted. The Phase control permits correction of possible phase errors between the 19 kHz pilot signals and the 38 kHz subcarrier signals that might occur between different stereo stations. Thus, it enables you to obtain maximum stereo separation from all stations.

Transistor Q411 amplifies the 19 kHz pilot signal. The primary of transformer T402 is tuned to 19 kHz by capacitor C451 and is connected to the collector of Q411. The pilot signal passes to the secondary of T402 and is rectified by dual diode D429. This dual diode acts as a full-wave rectifier which doubles the 19 kHz frequency and produces a 38 kHz pulsating DC voltage. This pulsating DC voltage is fed to three different circuits as follows:

A. To the Normal-Adjust switch on the FM tuner circuit board;

B. To 38 kHz oscillator transistor Q405; and

C. To 19 kHz pilot detector Q417.

The following is a description of the 38 kHz pulsating DC voltage function in these three circuits.

A. The pulsating DC voltage from dual diode D429 is coupled through resistor R469 to the Normal-Adjust switch on the FM tuner circuit board. When the switch is in the Adjust position, the Signal Meter is placed in the circuit to indicate the strength of the 19 kHz signal. This permits accurate adjustment of coil L409 and transformer T402 for maximum gain.

B. Capacitor C413 couples the pulsating DC voltage from dual diode D429 to the base of 38 kHz oscillator transistor Q405. This transistor acts as a grounded base oscillator. The primary winding of transformer T401 and capacitor C419 form the 38 kHz tuned circuit. This oscillator is synchronized with the 38 kHz subcarrier, both in frequency and phase, by the 38 kHz pulses from the dual diode D429.

C. Resistor R489 couples the pulsating DC voltage from dual diode D429 to the base of 19 kHz pilot detector Q417. Transistor Q417 detects the presence of a 19 kHz pilot signal and controls Q419, which automatically switches the stereo circuits on in the secondary circuit of transformer T401. This switching voltage is coupled through diode D432 and resistor R424.

The 19 kHz pilot signal applied through R494 from Q419 to Q420 also turns on the 38 kHz oscillator by reducing the amount of bias voltage applied to Q405 through R418 and R421. At the same time, while the pilot signal causes Q420 to conduct during the reception of a stereo signal, collector current flows through the FM Stereo indicator lamp and causes it to light.

Stereo switcher transistor Q419 is also controlled by a voltage from the 100 kHz noise amplifier and stereo threshold transistors Q415 and Q418, as described below.

100 kHz NOISE SIGNAL

If an FM signal is weak or not properly tuned in, noise signals accompany the composite program signal that is fed to the multiplex circuit. These noises could impair the listening pleasure if allowed to pass through the audio circuits to the loudspeakers. In this Tuner the noise signal itself is used to operate the squelch and stereo threshold circuits. With the Threshold switch in the MIN (minimum) position, the Stereo Threshold control (R499) can be adjusted so a certain noise level will switch off the stereo circuits and allow only monophonic reproduction, eliminating stereo noise. The Squelch control can be set to cut off the audio signal completely if the noise reaches a certain level. These circuits operate in the following manner.

The tuned circuit of coil L410 and capacitor C456 selects the noise signal at 100 kHz and couples it through capacitor C455 to the base of transistor Q413. (NOTE: Only noise is present in the region around 100 kHz; the highest frequency part of the transmitted signal only extends to 74 kHz, which is the SCA upper sideband.)

Transistors Q413 and Q414 amplify the noise signal. The amplified noise signal from Q414 is coupled through capacitor C458 to a voltage doubling detector circuit consisting of diodes D430 and D431. These diodes produce a negative DC voltage that is proportional to the amount of noise in the received signal. Capacitors C461, and C459, and resistor R483, filter out any remaining noise signal from the negative DC voltage coupled to the base of Q415.

Transistor Q415 is an emitter follower. Its output is coupled through R475 to the base of squelch threshold transistor Q412, and through R487 to the base of stereo threshold transistor Q418.

Transistor Q416 is direct coupled to the output of Q415 in such a way that a positive voltage applied to the base of Q416 has the same effect on Q412 as a negative voltage applied to the base of Q415. Thus, either a noise signal through Q415, or a deviation squelch voltage through Q416, will cause Q412 to conduct.

The amount of noise signal, or AFC squelch voltage, required to trigger transistor Q412 is determined by the setting of Squelch control R498. When the noise signal or deviation squelch voltage becomes strong enough to cancel the bias voltage on Q412, this transistor begins to conduct. This, in turn, removes the bias from Q401 and causes Q401 to cut off, and Q402 to conduct.

Transistors Q401 and Q402 control the bias voltages on dual diodes D427 and D428 which, in turn, control the passage of FM program signals from the audio amplifier stages and the filter networks. When a noise signal or deviation squelch voltage causes Q412 to conduct, with Q402 conducting and Q401 cut off, the bias on the cathodes of dual diodes D427 and D428 is changed to prevent these diodes from passing the audio signal. Dual diode D422 prevents the passage of audio signals from one channel to the other through R404 and R405, which would reduce the channel separation.

Stereo threshold transistor Q418 operates in a manner similar to squelch threshold transistor Q412. Bias for Q418 is adjusted by Stereo Threshold control R499, through resistor R488, to a point where a certain strength of noise signal or deviation squelch voltage will cause Q418 to conduct. The collector current of Q418 is then passed through R492 to the base of stereo switcher transistor Q419. Transistor Q419 switches the operation of the amplifier circuits to monophonic when the noise level is too high or the received signal is too weak for good stereo reproduction.

Notice that there are four ways transistor Q419 can be made to conduct and stop stereo operation:

1. In the absence of a 19 kHz pilot signal where collector current from Q417, through R491, causes Q419 to conduct. The 19 kHz pilot signal is absent when a station is transmitting in the monophonic mode.

2. When excessive noise through Q415 causes the collector current from stereo threshold transistor Q418 to flow through R492. This is the noise between stations or on weak stereo signals.

3. When a deviation squelch voltage controls Q416 and Q418, this deviation squelch voltage is produced in the FM tuner ratio detector when the Tuner is not tuned to the center frequency of an FM station.

4. When the Selector switch is in the Mono position. This causes a current to flow through R491 and causes Q419 to conduct and block stereo operation.

The Tuner can be made to pass only stereo signals by placing the Selector switch in the Stereo position. This switch position connects the collector of transistor Q420 through resistor R474 to squelch threshold transistor Q412. As transistor Q420 does not conduct on monophonic signals, its collector voltage is high. This voltage, which is returned to the collector of Q412, has the same effect as a strong noise signal. It causes transistors Q402 and Q401 to remove the bias voltage from dual diodes D427 and D428 and stop audio signals from passing through. When stereo signals are received, the voltage returned to the collector of Q412 is reduced, and transistors Q402 and Q401 bias the squelch diodes and permit audio signals to pass.

MONOPHONIC OPERATION

Monophonic FM signals received from the FM ratio detector circuit contain only audio frequencies from 50 Hz to 15 kHz. Without the 19 kHz pilot signal, the 38 kHz oscillator is not turned on and the Stereo Indicator lamp does not light. The audio signal is passed through the circuits of transistors Q403 and Q404 to the switching detector circuit.

Since no 19 kHz pilot signal is detected by transistor Q417, stereo switcher transistor Q419 is allowed to conduct. The circuit through diode D432 and resistor R424, from the collector of Q419, biases diodes D424 and D426 ON. This biasing allows these diodes to pass the audio signal to both the left and right audio circuits simultaneously.

AUDIO OUTPUT CIRCUITS

Resistor and capacitor numbers (100-199) in the audio circuits are further divided so that the odd numbers are in the left-channel circuits, and the even numbers are in the right-channel circuits. Transistors are designated L (left) and R (right). For example, Q101L in the left channel circuit is identical to Q101R in the right channel circuit.

The left and right channel audio circuits are identical in operation, so only the left-channel circuits will be described.

The left-channel audio signal from the multiplex circuit is fed to two separate audio output circuits; fixed and variable. Each of these circuits will be described separately.

VARIABLE OUTPUT CIRCUIT

The Multiplex audio signal is fed through Balance control R111, which consists of two separate controls operated from a common shaft. With the control shaft centered, each channel passes its full signal to its Level control. As the Balance control shaft is rotated clockwise from center, the left-channel signal is reduced without affecting the right-channel signal. When the Balance control is rotated counterclockwise from center, the right-channel signal is reduced without affecting the left-channel signal.

Level control R113 is also a dual-tandem control. It increases or decreases the left and right channel signals simultaneously.

From the Level control, the signal passes through resistor R115 and capacitor C105 to the base of transistor Q101L. Transistors Q101L, Q102L, and Q103L function as a three-stage, direct-coupled amplifier. Q101L is a high impedance amplifier that is used to minimize loading of the incoming signal. The signal is then amplified by Q102L and direct coupled to the base of Q103L. Q103L operates as an emitter follower to provide a low output impedance for headphones.

The output signal from the emitter of Q103L is coupled through capacitor C109 to isolation resistors R131, R133, and R135. Resistor R133 passes the signal to the left-channel Variable output connector on the rear of the chassis. The left-channel signal passes through resistors R131 and R135 to the Phone jacks located on the front panel.

FIXED OUTPUT CIRCUITS

The left-channel multiplex audio signal is also fed through capacitor C101 to the base of transistor Q104L. The signal is amplified by Q104L and coupled through capacitor C103 to isolation resistors R107 and R109. Resistor R107 passes the signal to the Tape output connector on the rear of the chassis while R109 passes the signal to the Fixed output connector on the rear of the chassis.

POWER SUPPLY CIRCUITS

The transformer-operated power supply circuit, which consists mainly of three transistors, two silicon rectifiers, and a zener diode, provides the various voltages used in the Tuner. An AC receptacle is also provided on the rear of the chassis for supplying power to auxiliary equipment. This receptacle is "hot" whenever the line cord is plugged in.

The input line voltage passes through the fuse and the Power switch to the primary windings of the power transformer. When connected for 120 volt operation, the two primary windings are in parallel. For 240 volt operation, the windings are connected in series, and a (electrically) smaller fuse (1/4 ampere) should be used for proper circuit protection. The two secondary windings step down the line voltage to the amounts required.

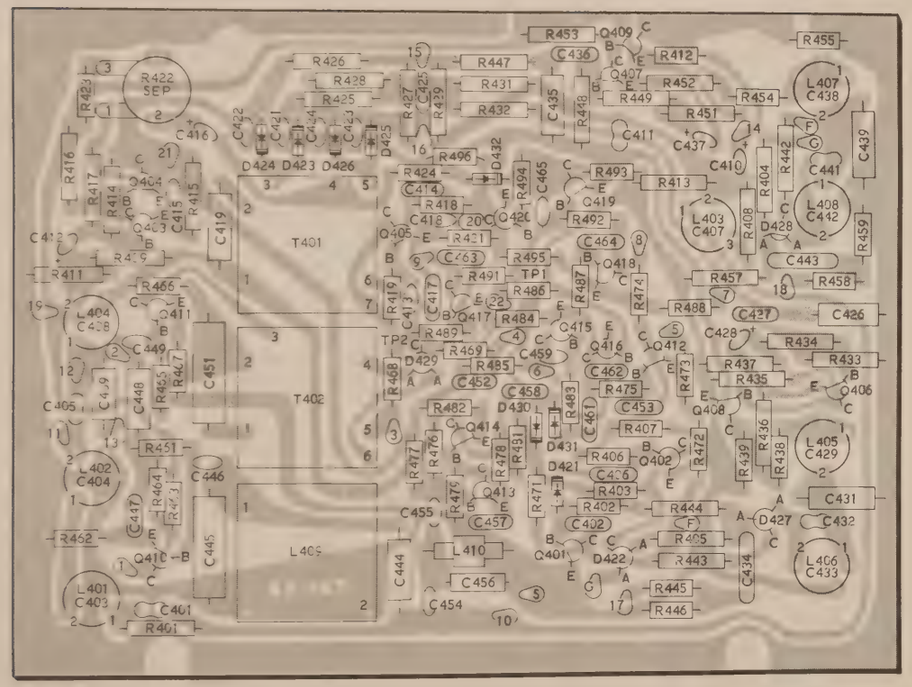
One secondary winding of the power transformer supplies voltage to a full-wave rectifier circuit consisting of diodes D501 and D502. The output of the rectifier circuit is filtered by capacitor C501. Capacitor C502 removes most of the 120 hertz ripple on the zener diode.

Resistor R501 establishes the proper current for D503. D503 operates as a reference diode for the 16 volts that is applied to the base of Q501. Transistors Q501 and Q502 operate as a variable electronic load which maintains the voltage at the emitter of Q502 at 15 volts. Q503 operates the same as Q502 to maintain 12 volts at its emitter. These three transistors (Q501, Q502, and Q503) also provide electronic filtering.

The 15 volts DC is supplied to the FM front end, IF amplifiers, and the fixed audio output amplifiers. The 12 volt supply is used by the multiplex circuits and the variable audio output circuits.

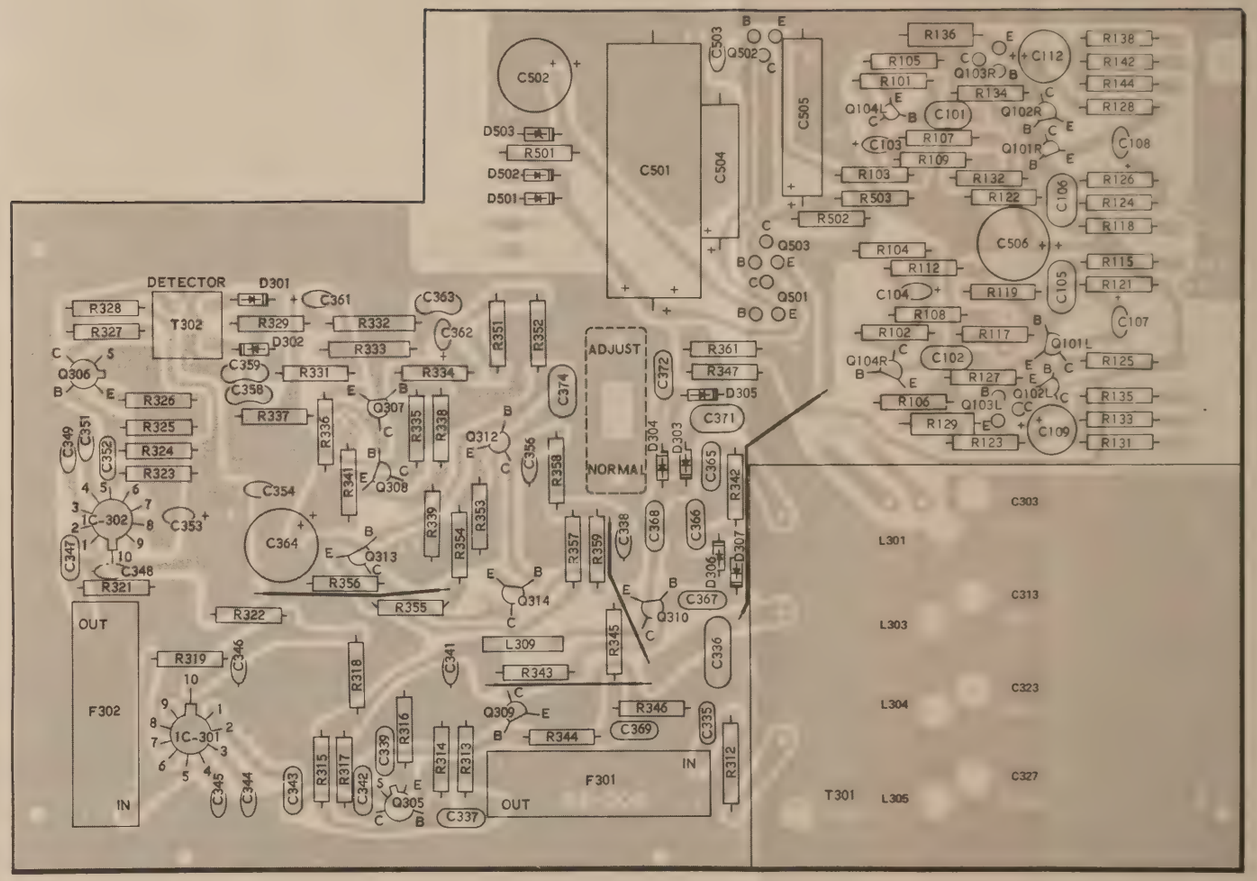
The other secondary winding of the power transformer provides the proper voltage for the dial lamps.

CIRCUIT BOARD X-RAY VIEWS



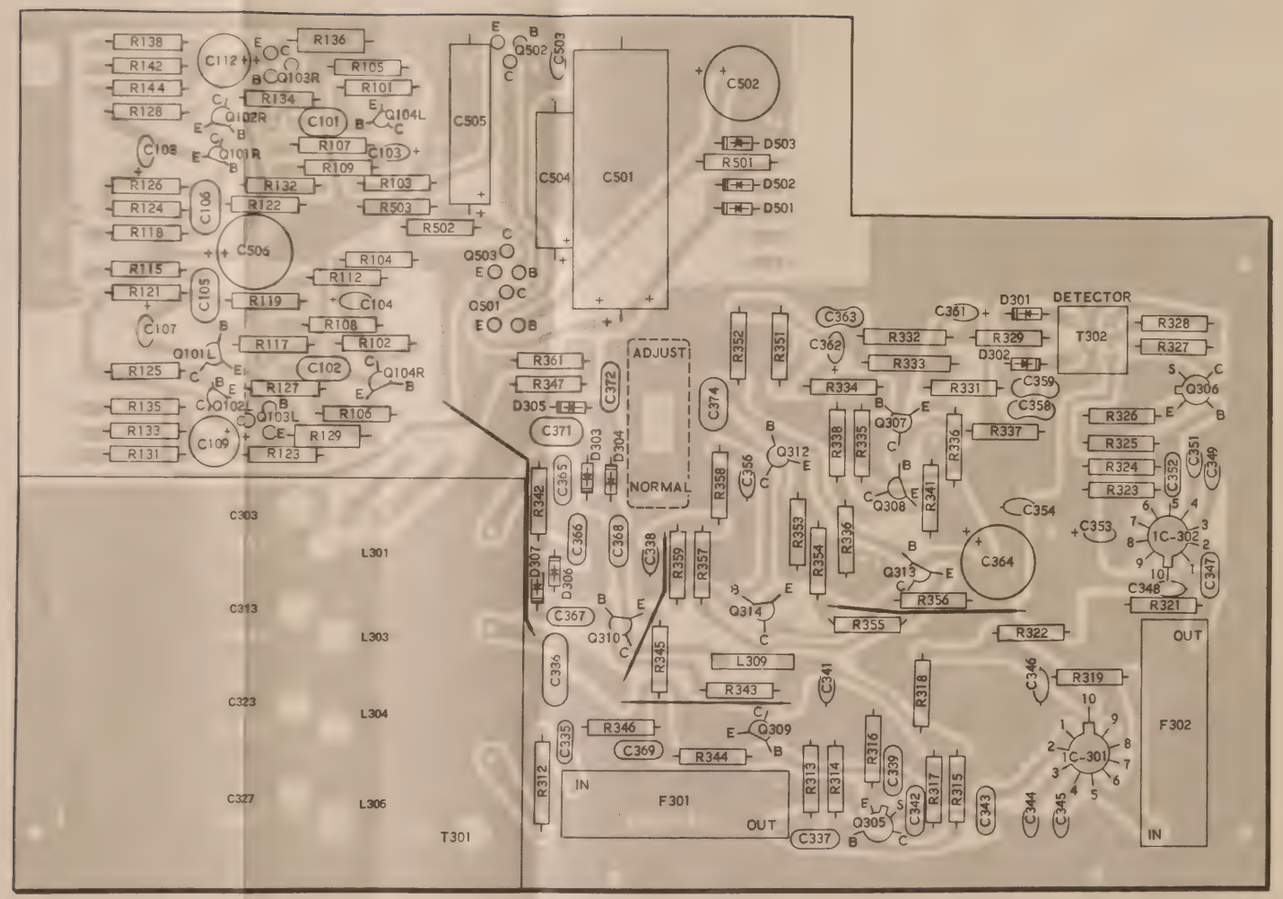
MULTIPLEX CIRCUIT BOARD

(VIEWED FROM FOIL SIDE)



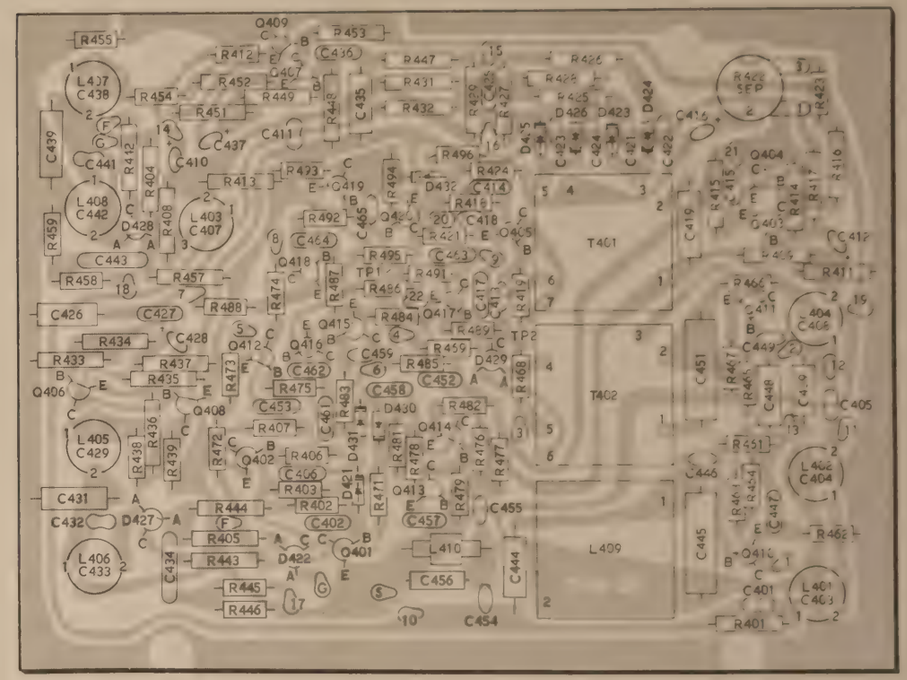
FM CIRCUIT BOARD

(VIEWED FROM FOIL SIDE)



FM CIRCUIT BOARD

(VIEWED FROM COMPONENT SIDE)



MULTIPLEX CIRCUIT BOARD

(VIEWED FROM COMPONENT SIDE)

VOLTAGE CHARTS



NOTES

SELECTOR: MONO
SQUELCH: FULL CCW
STEREO THRESH: MIN

SELECTOR: MONO
SQUELCH: FULL CW
STEREO THRESH: MIN
ANTENNA: NOT CONNECTED

SELECTOR: STEREO
STEREO THRESH: MIN
ANTENNA: CONNECTED
TUNE METER: CENTER SCALE

SAME AS △ EXCEPT
TUNE METER: LEFT END.

SAME AS △ EXCEPT
TUNE METER: RIGHT END.

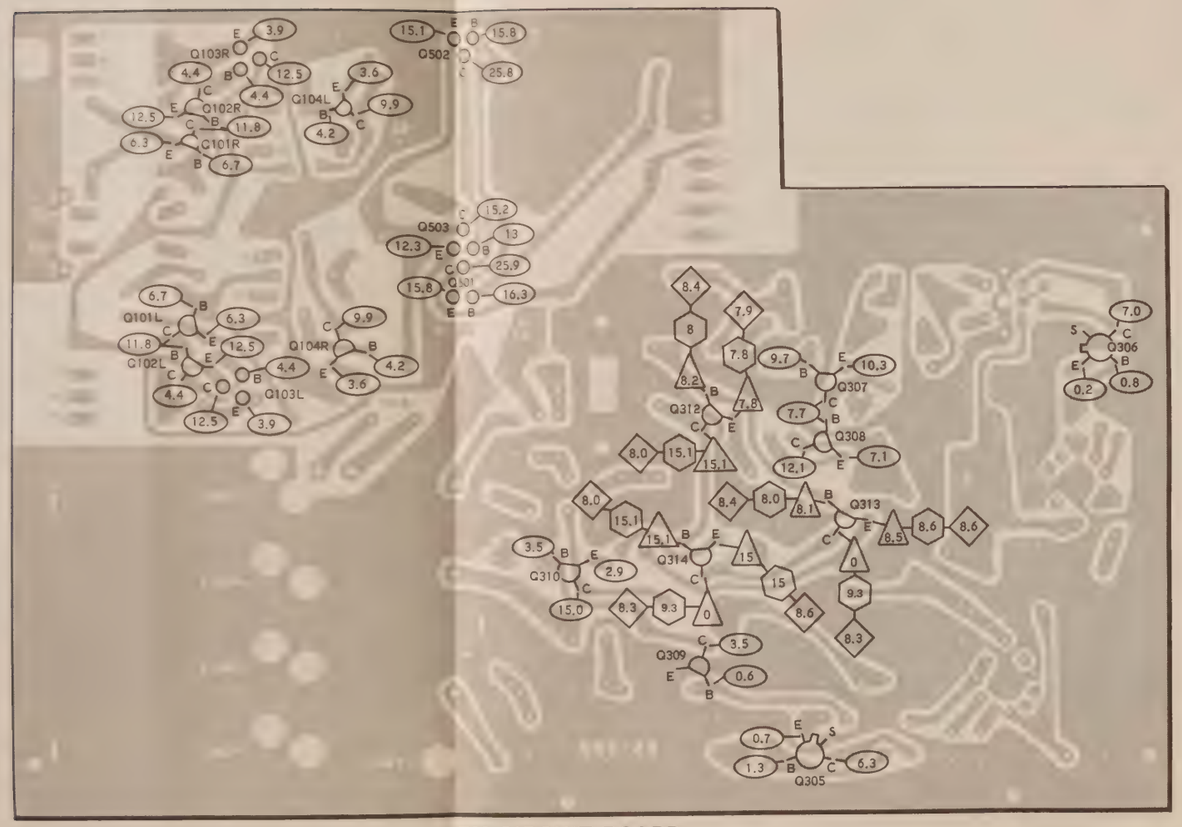
MULTIPLEX CIRCUIT BOARD

(VIEWED FROM FOIL SIDE)



FM CIRCUIT BOARD

(VIEWED FROM FOIL SIDE)



FM CIRCUIT BOARD

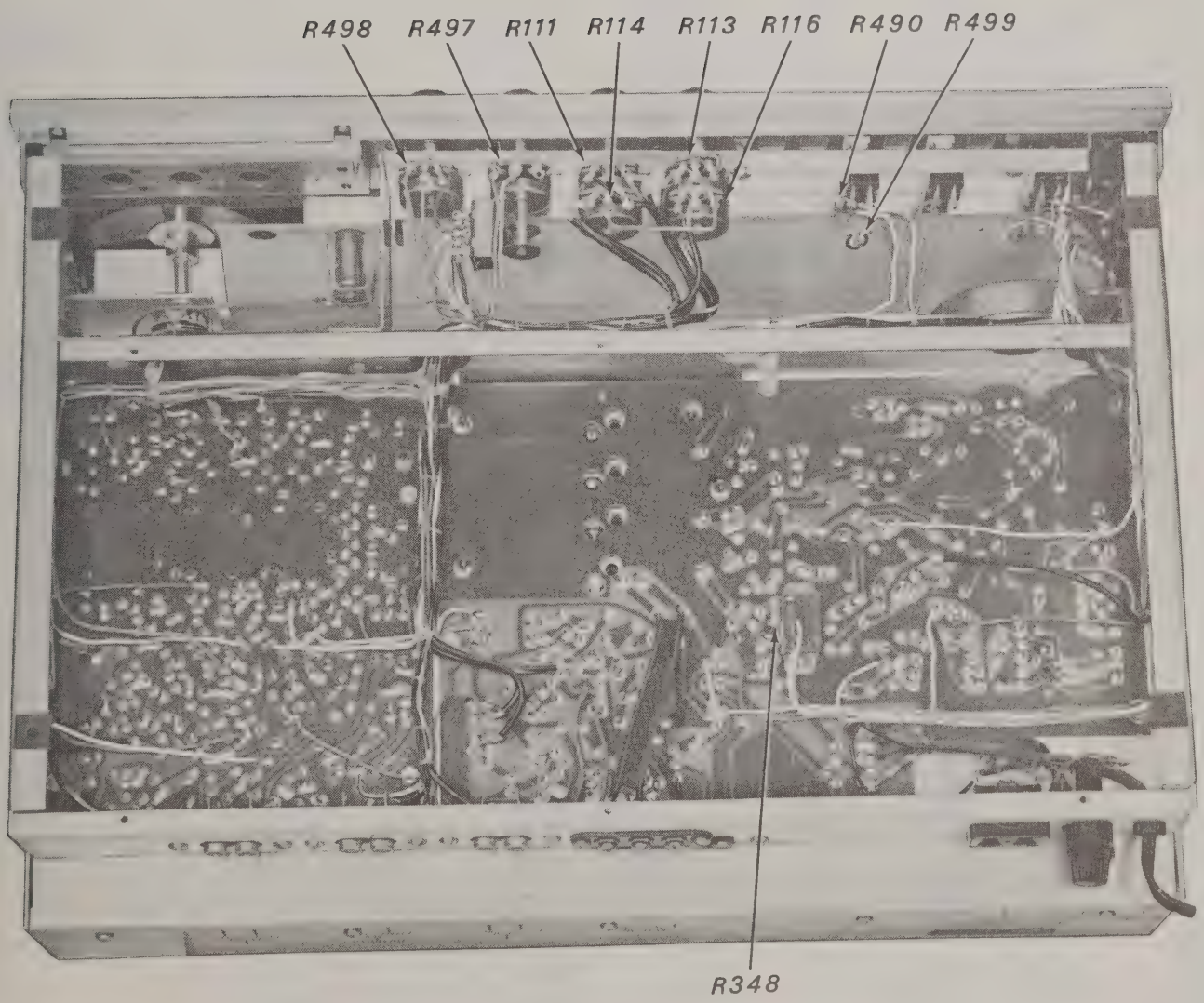
(VIEWED FROM COMPONENT SIDE)



MULTIPLEX CIRCUIT BOARD

(VIEWED FROM COMPONENT SIDE)

CHASSIS PHOTOGRAPH



REPLACEMENT PARTS PRICE LIST

The following prices apply only on purchases from the Heath Company where shipment is to a U.S.A. destination. Add 10% (minimum 25 cents) to the price when ordering (Michigan residents add 4% sales tax) to cover insurance, postage, and handling. Outside the U.S.A. parts and service are available from your local Heathkit source and will reflect additional transportation, taxes, duties, and rates of exchange.

To order replacement parts, refer to the Replacement Parts Price List and use the Parts Order Form furnished with this kit.

MULTIPLEX CIRCUIT BOARD

PART No.	PRICE Each	DESCRIPTION
RESISTORS		
1/2 Watt (carbon)		
1-1	.15	47 Ω
1-42	.15	270 Ω
1-4	.15	330 Ω
1-48	.15	390 Ω
1-6	.15	470 Ω
1-9	.15	1000 Ω
1-10	.15	1200 Ω
1-11	.15	1500 Ω
1-44	.15	2200 Ω
1-19	.15	6800 Ω
1-73	.15	8200 Ω
1-20	.15	10 kΩ
1-21	.15	15 kΩ
1-22	.15	22 kΩ
1-23	.15	27 kΩ
1-25	.15	47 kΩ
1-60	.15	68 kΩ
1-26	.15	100 kΩ
1-27	.15	150 kΩ
1-29	.15	220 kΩ
1-35	.15	1 MΩ
1-38	.15	3.3 MΩ
1/2 Watt 5% (low-noise)		
4-15	.15	1000 Ω
4-18	.15	3300 Ω
4-19	.15	3900 Ω
4-20	.15	4700 Ω
4-37	.15	6800 Ω
4-38	.15	9100 Ω
4-22	.15	10 kΩ
4-39	.15	12 kΩ
4-23	.15	22 kΩ
4-25	.15	27 kΩ
4-26	.15	33 kΩ
4-27	.15	47 kΩ
4-29	.15	220 kΩ
4-32	.15	390 kΩ
4-46	.15	1.5 MΩ
CAPACITORS		
Disc		
21-7	.15	33 pF
21-75	.15	100 pF
21-56	.15	470 pF
21-140	.15	.001 μF
21-27	.15	.005 μF
21-82	.15	.02 μF
21-100	.60	.47 μF

PART No.	PRICE Each	DESCRIPTION
Mica		
20-108	.30	200 pF
20-115	.40	300 pF
20-107	.60	680 pF
Mylar		
27-74	.15	.01 μF
27-73	.25	.047 μF
27-47	.30	.1 μF
27-85	.30	.22 μF
Polystyrene		
29-5	.15	1000 pF
29-6	.15	1200 pF
29-4	.15	1800 pF
29-3	.25	2700 pF
29-8	.25	3300 pF
29-9	.25	8200 pF
29-2	.25	10,000 pF (.01 μF)
Electrolytic		
25-220	.70	10 μF tantalum
25-223	2.25	47 μF tantalum

PART No.	PRICE Each	DESCRIPTION
TRANSISTORS-DIODES		
417-94	1.00	2N3416 transistor
417-118	.40	2N3393 transistor
417-201	.50	X29A829 transistor
56-26	.40	1N191 diode
56-614	.85	Dual diode (MSD6101)
COILS-CHOKE-CONTROL-CONNECTOR-SOLDER		
40-787	2.50	7 mH coil (67 kHz trap)
40-788	3.00	20 mH coil (19 kHz trap)
40-789	3.35	23 mH coil (53 kHz lowpass)
40-790	3.10	70 mH coil
40-786	5.25	7 mH coil (19 kHz amplifier)
40-791	5.65	7 mH coil (19 kHz doubler)
40-792	6.15	7 mH coil (38 kHz oscillator)
45-47	1.00	2 mH RF choke
10-155	1.00	750 Ω control
259-20	.05	Connector pin
331-6	.25	Solder
ITEMS FROM PACKAGE 3		
85-167-5	4.55	Multiplex circuit board
390-1163		Certification label
	2.00	Manual (See front cover for part number.)

FM CIRCUIT BOARD

PART No.	PRICE Each	DESCRIPTION
RESISTORS		
1/2 Watt 1% (precision)		
2-111	1.00	400 Ω
2-181	1.00	5490 Ω (5.49k)
2-50	1.00	10 kΩ
1/2 Watt 5% (low-noise)		
4-55	.15	33 Ω
4-56	.15	47 Ω
4-8	.15	82 Ω
4-57	.15	100 Ω
4-58	.15	150 Ω
4-59	.15	220 Ω
4-12	.15	390 Ω
4-60	.15	470 Ω
4-13	.15	510 Ω
4-61	.15	560 Ω
4-14	.25	620 Ω
4-62	.15	820 Ω
4-15	.15	1000 Ω
4-41	.15	1500 Ω
4-17	.15	2200 Ω
4-65	.15	2400 Ω
4-63	.15	2700 Ω
4-18	.15	3300 Ω
4-20	.15	4700 Ω
4-54	.15	5600 Ω
4-37	.15	6800 Ω
4-21	.15	8200 Ω
4-22	.15	10 kΩ
4-25	.15	27 kΩ
4-27	.15	47 kΩ
4-64	.15	68 kΩ
4-45	.15	82 kΩ
4-34	.15	100 kΩ
4-35	.15	180 kΩ
4-6	.15	1 MΩ
4-66	.15	1.2 MΩ
4-46	.15	1.5 MΩ
Other Resistor		
1-17-1	.15	100 Ω 1 watt
CAPACITORS		
Mica		
20-102	.25	100 pF
20-139	.40	330 pF
Disc		
21-78	.15	5 pF
21-82	.15	.02 μF
21-48	.25	.05 μF
Mylar		
27-74	.15	.01 μF
27-47	.30	.1 μF
27-85	.30	.22 μF
Electrolytic		
25-220	.70	10 μF tantalum
25-223	2.25	47 μF tantalum
25-117	.75	100 μF vertical
25-148	1.45	1000 μF 15 V vertical
25-164	1.05	1000 μF 25 V vertical
25-146	.70	100 μF tubular
25-175	.85	250 μF tubular
25-154	2.05	2500 μF tubular
TRANSISTORS-INTEGRATED CIRCUITS-DIODES		
417-83	.75	L842 transistor
417-91	.85	2N5232A transistor
417-118	.40	2N3393 transistor
417-201	.50	X29A829 transistor
417-133	2.00	40245 transistor
417-175	1.45	TA2911 transistor
417-123	4.20	Integrated circuit (CA3012)
56-26	.40	1N191 diode
56-36	2.25	Zener diode (16.1 V)
57-27	.75	Silicon diode
GENERAL		
40-583	1.00	10 μH peaking coil
60-4	.30	SPDT slide switch
53-11	5.00	Ratio detector transformer
252-2	.05	4-40 nut
254-9	.05	#4 lockwasher
250-56	.05	6-32 x 1/4" screw
404-383	23.40	10.7 MHz crystal filter
344-52	.05/ft	Red hookup wire
490-5	.15	Plastic nut starter
ITEMS FROM PACK 3		
110-39*	45.80	FM tuning unit
85-300-2	5.00	FM circuit board

*If your old tuner is repairable, you can return it to the Heath Company for a credit or rebate against the cost of the replacement tuner (after you get the replacement tuner if you prefer). You can also return it to a Heathkit Electronic Center.

CHASSIS

PART No.	PRICE Each	DESCRIPTION
TRANSISTOR-LAMPS-FUSE		
417-175	1.45	TA2911 transistor
412-14	.25	#44 pilot lamp
412-39	.90	#1813 pilot lamp
421-20	.50	1/2 ampere slow-blow fuse
SWITCHES-CONTROLS		
60-31	.90	DPDT rocker switch (white)
60-32	1.05	DPDT rocker switch (black)
63-480	2.20	3-position rotary switch
10-168	1.45	500 Ω control (with leads)
10-235	1.60	1000 Ω control
12-86	3.60	250 kΩ tandem control
12-87	2.10	250 kΩ tandem control
19-120	3.80	10 kΩ control with DPDT switch
SOCKETS		
434-85	.15	Pilot lamp socket (with lead)
434-171	.20	Pilot lamp socket (without lead)
434-174	.15	Dual phono socket
434-147	.25	AC socket
TERMINAL STRIP-PHONE JACKS-FUSEHOLDER		
431-8	.15	Screw-type terminal strip
436-27	.55	Phone jack
423-2	.95	Fuseholder
INSULATORS-FEET		
73-3	.15	1/2" rubber grommet
73-2	.15	3/4" rubber grommet
75-24	.15	Line cord strain relief
75-68	.25	Insulator sheet (adhesive backed)

PART No.	PRICE Each	DESCRIPTION
Insulators -Feet (cont'd.)		
75-87	.30	Feedthrough insulator
75-96	.15	Phono socket insulator
75-704	.15	Transistor insulator
261-17	.05	Plastic foot
432-67	.15	Wire nut
DIAL PARTS		
100-622	.25	Dial pulley
100-642	.40	Dial drum
100-643	.15	Dial cord
258-1	.05	Dial spring
453-159	.65	Dial shaft
454-2	1.35	Flywheel
463-44	.45	Dial pointer
FRONT PANEL ASSEMBLY		
100-621	.55	Indicator disc
203-460	7.10	Front panel
204-757	.95	Meter bracket
205-583	2.10	Trim panel
407-115	5.20	Tuning meter
407-116	5.00	Signal meter
266-93	.40	Dial pointer rail
446-68	4.30	Dial window (black)
446-60	.15	Meter shield (green)
446-57	2.30	Tinted window
390-194	.25	Door trim label
205-689	3.40	Cover plate
CHASSIS PARTS		
202-73	1.80	Rear apron
202-72	1.30	Right apron
202-71	1.35	Left apron
201-42	4.00	Chassis
204-756	5.00	Tuning shaft bracket
206-330-1	2.10	Large light reflector
204-753	.45	Switch bracket
206-331-1	.30	Light shield
206-332-1	.45	Small light reflector
204-832	1.05	Control bracket
205-582	2.65	Bottom plate

GENERAL

PART No.	PRICE Each	DESCRIPTION
4-62	.15	820 Ω 5% low-noise resistor
4-63	.15	2700 Ω 5% low-noise resistor
54-199	7.60	Power transformer
73-39	.15	Length foam tape
89-13	.75	Line cord
134-36	1.15	Shielded cable with phono plugs
134-174	7.15	Wiring harness
344-50	.05/ft	Black hookup wire
347-2	.05/ft	300 Ω twin lead
352-13	.25	Silicone grease
462-269	5.40	Small knob
462-268	5.40	Large knob
490-109	.15	Small alignment tool
490-1	.15	Large alignment tool
413-40	1.00	Red lamp cover

HARDWARE

#4 Hardware

PART No.	PRICE Each	DESCRIPTION
250-52	.05	4-40 x 1/4" screw
252-2	.05	4-40 nut
254-9	.05	#4 lockwasher

#6 Hardware

PART No.	PRICE Each	DESCRIPTION
250-170	.05	#6 x 1/4" sheet metal screw
250-56	.05	6-32 x 1/4" screw
250-116	.05	6-32 x 1/4" black screw
250-100	.05	6-32 x 5/16" setscrew
250-89	.05	6-32 x 3/8" binder head screw

#6 Hardware (cont'd.)

PART No.	PRICE Each	DESCRIPTION
250-276	.05	6-32 x 3/8" flat head black screw
250-298	.05	6-32 x 3/4" screw
252-3	.05	6-32 nut
252-22	.05	6-32 speednut
253-21	.05	Flat washer
253-2	.05	#6 fiber shoulder washer
254-1	.05	#6 lockwasher
259-1	.05	#6 solder lug
255-71	.15	6-32 tapped spacer

#8 Hardware

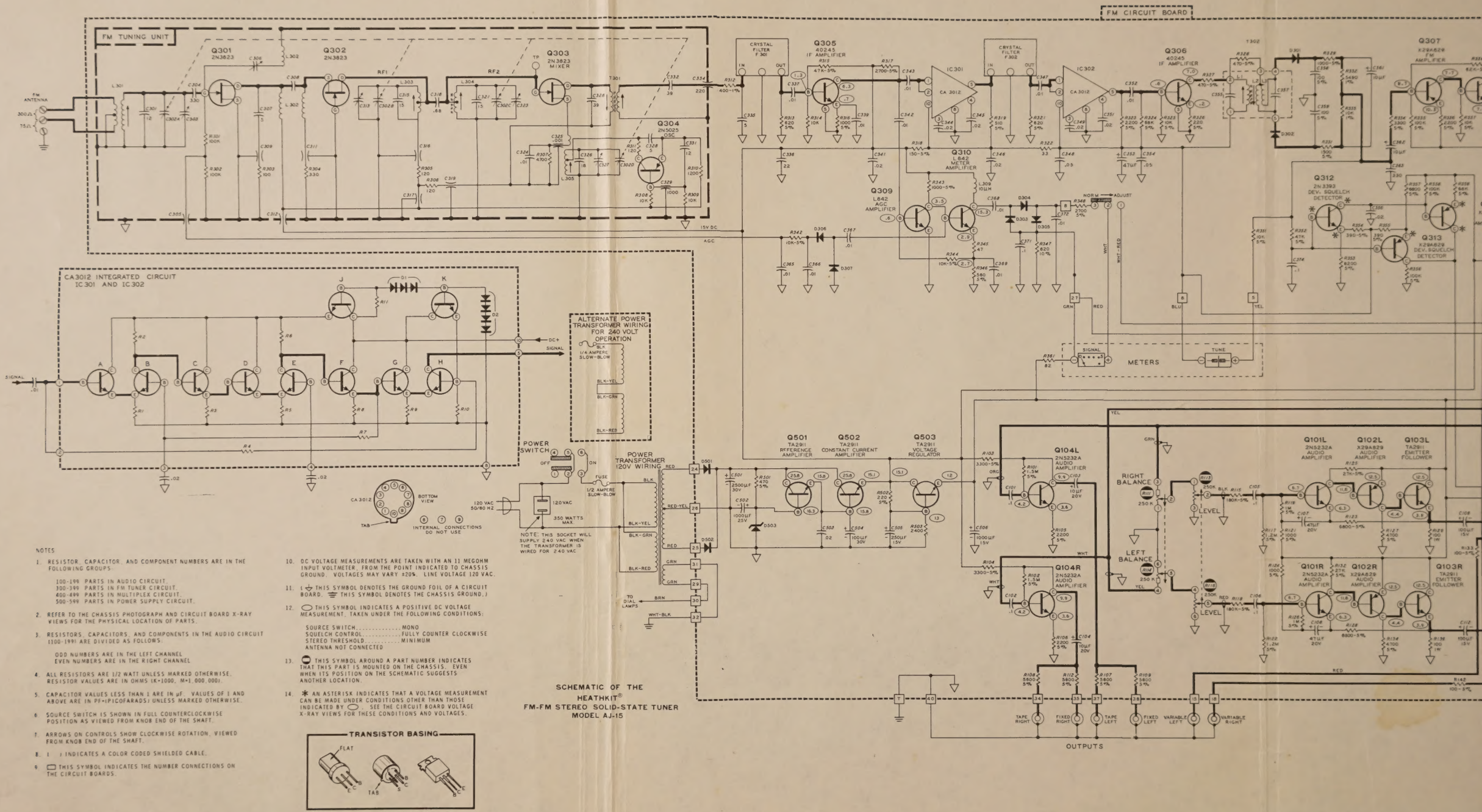
PART No.	PRICE Each	DESCRIPTION
250-16	.05	8-32 x 3/16" setscrew
250-43	.05	8-32 x 1/4" setscrew
250-22	.10	8-32 x 7/16" setscrew
259-24	.05	#8 solder lug

1/4" Hardware

PART No.	PRICE Each	DESCRIPTION
253-11	.05	E washer
253-36	.05	Spring washer
253-49	.10	Nylon flat washer
253-112	.05	Felt washer

3/8" Hardware

PART No.	PRICE Each	DESCRIPTION
252-7	.05	Control nut
254-5	.05	Control lockwasher



SCHEMATIC OF THE
HEATHKIT®
FM-FM STEREO SOLID-STATE TUNER
MODEL AJ-15

NOTES

1. RESISTOR, CAPACITOR, AND COMPONENT NUMBERS ARE IN THE FOLLOWING GROUPS:

   100-199 PARTS IN AUDIO CIRCUIT.
   300-399 PARTS IN FM TUNER CIRCUIT.
   400-499 PARTS IN MULTIPLEX CIRCUIT.
   500-599 PARTS IN POWER SUPPLY CIRCUIT.

2. REFER TO THE CHASSIS PHOTOGRAPH AND CIRCUIT BOARD X-RAY VIEWS FOR THE PHYSICAL LOCATION OF PARTS.

3. RESISTORS, CAPACITORS, AND COMPONENTS IN THE AUDIO CIRCUIT (100-199) ARE DIVIDED AS FOLLOWS:

   ODD NUMBERS ARE IN THE LEFT CHANNEL.
   EVEN NUMBERS ARE IN THE RIGHT CHANNEL.

4. ALL RESISTORS ARE 1/2 WATT UNLESS MARKED OTHERWISE. RESISTOR VALUES ARE IN OHMS (K=1000, M=1,000,000).

5. CAPACITOR VALUES LESS THAN 1 ARE IN µF. VALUES OF 1 AND ABOVE ARE IN PF=(PICOFARADS) UNLESS MARKED OTHERWISE.

6. SOURCE SWITCH IS SHOWN IN FULL COUNTERCLOCKWISE POSITION AS VIEWED FROM KNOB END OF THE SHAFT.

7. ARROWS ON CONTROLS SHOW CLOCKWISE ROTATION, VIEWED FROM KNOB END OF THE SHAFT.

8. ( ) INDICATES A COLOR CODED SHIELDED CABLE.

9. ▭ THIS SYMBOL INDICATES THE NUMBER CONNECTIONS ON THE CIRCUIT BOARDS.

10. DC VOLTAGE MEASUREMENTS ARE TAKEN WITH AN 11 MEGOHM INPUT VOLTMETER, FROM THE POINT INDICATED TO CHASSIS GROUND. VOLTAGES MAY VARY ±20%. LINE VOLTAGE 120 VAC.

11. (⏚ THIS SYMBOL DENOTES THE GROUND FOIL OF A CIRCUIT BOARD. ⏚ THIS SYMBOL DENOTES THE CHASSIS GROUND.)

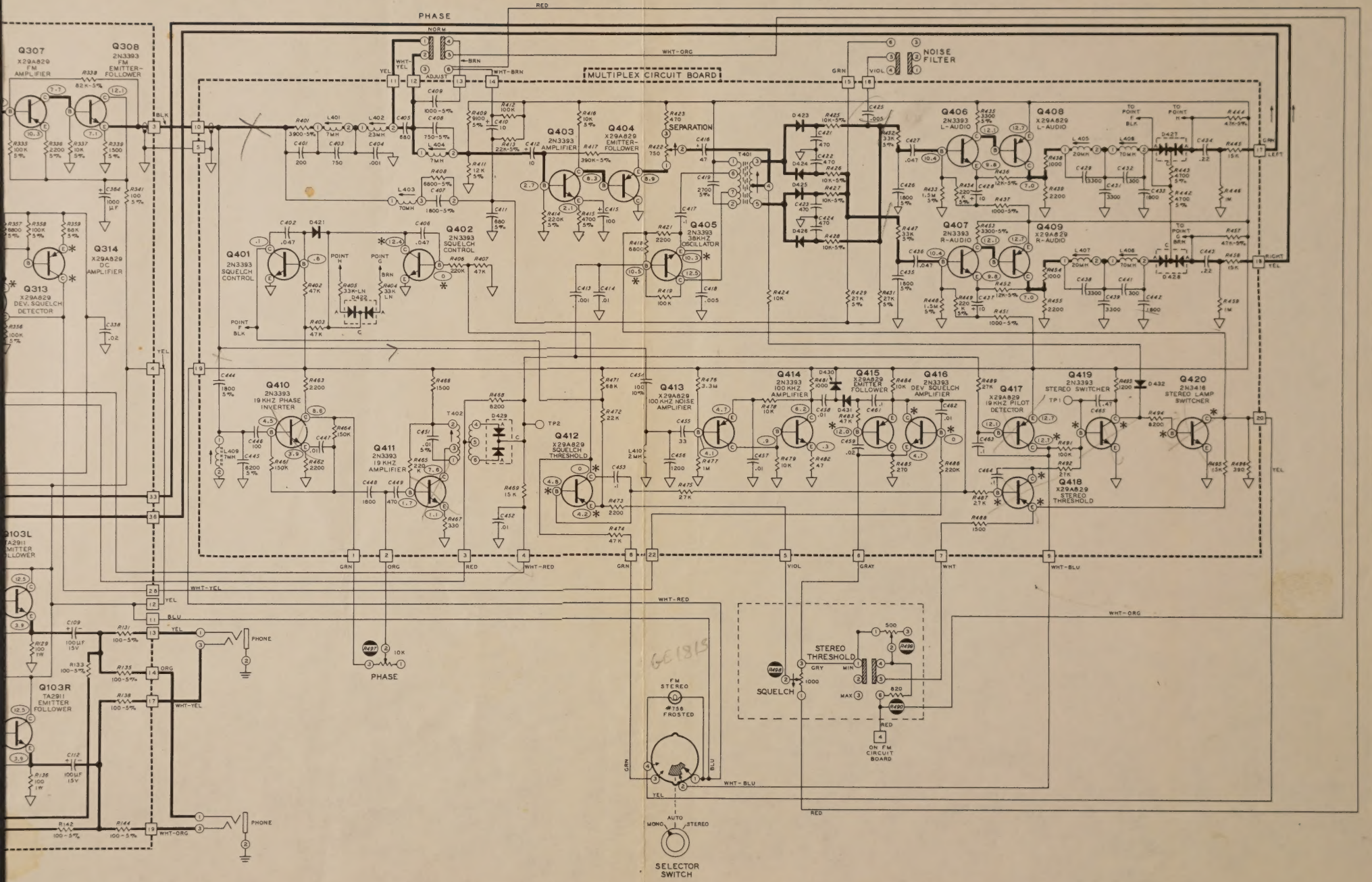
12. ⬭ THIS SYMBOL INDICATES A POSITIVE DC VOLTAGE MEASUREMENT, TAKEN UNDER THE FOLLOWING CONDITIONS:

    SOURCE SWITCH.....MONO
    SQUELCH CONTROL.....FULLY COUNTER CLOCKWISE
    STEREO THRESHOLD.....MINIMUM
    ANTENNA NOT CONNECTED

13. ⬭ THIS SYMBOL AROUND A PART NUMBER INDICATES THAT THIS PART IS MOUNTED ON THE CHASSIS. EVEN WHEN ITS POSITION ON THE SCHEMATIC SUGGESTS ANOTHER LOCATION.

14. * AN ASTERISK INDICATES THAT A VOLTAGE MEASUREMENT CAN BE MADE UNDER CONDITIONS OTHER THAN THOSE INDICATED BY ⬭. SEE THE CIRCUIT BOARD VOLTAGE X-RAY VIEWS FOR THESE CONDITIONS AND VOLTAGES.

TRANSISTOR BASING


MULTIPLEX CIRCUIT BOARD
PHASE
NORM
ADJUST
NOISE FILTER
SEPARATION
Q307 X29A829 FM AMPLIFIER
Q308 2N3393 FM EMITTER-FOLLOWER
Q314 X29A829 DC AMPLIFIER
Q313 X29A829 DEV. SQUELCH DETECTOR
Q401 2N3393 SQUELCH CONTROL
Q402 2N3393 SQUELCH CONTROL
Q403 2N3393 AMPLIFIER
Q404 X29A829 EMITTER-FOLLOWER
Q405 2N3393 38KHZ OSCILLATOR
Q406 2N3393 L-AUDIO
Q407 2N3393 R-AUDIO
Q408 X29A829 L-AUDIO
Q409 X29A829 R-AUDIO
Q410 2N3393 19 KHZ PHASE INVERTER
Q411 2N3393 19 KHZ AMPLIFIER
Q412 X29A829 SQUELCH THRESHOLD
Q413 X29A829 100 KHZ NOISE AMPLIFIER
Q414 2N3393 100 KHZ AMPLIFIER
Q415 X29A829 EMITTER FOLLOWER
Q416 2N3393 DEV SQUELCH AMPLIFIER
Q417 X29A829 19 KHZ PILOT DETECTOR
Q418 X29A829 STEREO THRESHOLD
Q419 2N3393 STEREO SWITCHER
Q420 2N3416 STEREO LAMP SWITCHER
Q103L TA2911 EMITTER FOLLOWER
Q103R TA2911 EMITTER FOLLOWER
PHASE
SQUELCH
STEREO THRESHOLD
FM STEREO #756 FROSTED
SELECTOR SWITCH
AUTO
MONO
STEREO
PHONE
ON FM CIRCUIT BOARD
POINT F BLK
POINT G BRN
TO POINT F BLK
TO POINT G BRN
TP1
TP2
LEFT
RIGHT
WHT-YEL
WHT-RED
WHT-ORG
WHT-BRN
WHT-BLU
GRN
YEL
RED
BLK
BLU
ORG
VIOL
GRAY
WHT
GRY

CUSTOMER SERVICE

REPLACEMENT PARTS

If you need a replacement part, please fill in the Parts Order Form that is furnished and mail it to the Heath Company. Or, if you write a letter, include the:

- **Part number** and **description** as shown in the **Parts List.**
- Model number and Series number from the blue and white label.
- Date of purchase.
- Nature of the defect.

Please do not return parts to the factory unless they are requested. Parts that are damaged through carelessness or misuse by the kit builder will not be replaced without cost, and will not be considered in warranty.

Parts are also available at the Heathkit Electronic Centers listed in your catalog. Be sure to provide the Heath part number. Bring in the original part when you request a warranty replacement from a Heathkit Electronic Center.

NOTE: Replacement parts are maintained specifically to repair Heathkit products. Parts sales for other reasons will be declined.

TECHNICAL CONSULTATION

Need help with your kit? . . . . Self-Service? . . . . Construction? . . . . Operation? . . . . Call or write for assistance. You'll find our Technical Consultants eager to help with just about any technical problem except "customizing" for unique applications.

The effectiveness of our consultation service depends on the information you furnish. Be sure to tell us:

- The Model number and Series number from the blue and white label.
- The date of purchase.
- An exact description of the difficulty.
- Everything you have done in attempting to correct the problem.

Also include switch positions, connections to other units, operating procedures, voltage readings, and any other information you think might be helpful.

Please do not send parts for testing, unless this is specifically requested by our Consultants.

Hints: Telephone traffic is lightest at midweek. . .please be sure your Manual and notes are on hand when you call.

Heathkit Electronic Center facilities are also available for telephone or "walk-in" personal assistance.

REPAIR SERVICE

Service facilities are available, if they are needed, to repair your completed kit. (Kits that have been modified, soldered with paste flux or acid core solder, cannot be accepted for repair.)

If it is convenient, personally deliver your kit to a Heathkit Electronic Center. For warranty parts replacement, supply a copy of the invoice or sales slip.

If you prefer to ship your kit to the factory, attach a letter containing the following information directly to the unit:

- Your name and address.
- Date of purchase.
- Copies of all correspondence relevant to the service of the kit.
- A brief description of the difficulty.
- Authorization to return your kit C.O.D. for the service and shipping charges. (This will reduce the possibility of delay.)

Check the equipment to see that all screws and parts are secured. (Do not include any wooden cabinets or color television picture tubes, as these are easily damaged in shipment.) Place the equipment in a strong carton with at least THREE INCHES of *resilient* packing material (shredded paper, excelsior, etc.) on all sides. Use additional packing material where there are protrusions (control sticks, large knobs, etc.). If the unit weighs over 15 lbs., place this carton in another one with 3/4" of packing material between the two.

Seal the carton with reinforced gummed tape, tie it with a strong cord, and mark it "Fragile" on at least two sides. Remember, the carrier will not accept liability for shipping damage if the unit is insufficiently packed. Ship by prepaid express, United Parcel Service, or insured Parcel Post to:

Heath Company
Service Department
Benton Harbor, Michigan 49022

HEATH

Schlumberger

HEATH COMPANY • BENTON HARBOR, MICHIGAN

THE WORLD'S FINEST ELECTRONIC EQUIPMENT IN KIT FORM

LITHO IN U.S.A.